8-Channel Charge Pump LED Driver

with Ambient Light Control and Four Integrated LDOs

BD6084GUL

●General Description

BD6084GUL is “Intelligent LED Driver” that is the most suitable for the cellular phone. It has 3 to 8LED driver and output variable LDO4ch for LCD Backlight.
It has ALC function that is “Low Power Consumption System” realized. It can be developed widely from the High End model to the Low End model. As it has charge pump circuit for LED power supply, it is no need to use coils, and it contributes to small space.
VCSP50L3 (3.15mm x 3.45mm x 0.5mm pitch)
It adopts the very thin CSP package that is the most suitable for the slim phone.

●Features

■ Total 3 to 8LEDs driver for LCD Backlight
- It has 4LEDs (it can select 4LED or 3LED) for exclusire use of Main and 4LEDs which can chose independent control or a main allotment by resister setting.
- “Main Group” can be controlled by Auto Luminous Control (ALC) system.
- “Main Group” can be controlled by external PWM signal.
- ON/ Off and a setup of LED current are possible at the time of the independent control by the independence.

■ Ambient Light sensor interface
- Incorporates various functions such as a sensor bias adjustment function, an ADC with an average filter, a gain adjustment function and an LOG conversion function so that options can be increased for illumination intensity sensors (Photo Diode, Photo Transistor, Photo IC (Linear / LOG)).
- Incorporates an auto gain switching function for suppressing an illumination intensity sensor current at high illumination intensity and improving sensitivity at low illumination intensity
- Capable of customizing an LED current value according to a table setting.
- Slope control loading and an independent control change are possible.

■ Charge Pump DC/DC for LED driver
- It has x1/x1.5/ x2 mode that will be selected automatically.
- The most suitable voltage up magnification is controlled automatically by LED port voltage.
- Soft start functions,Over voltage protection (Auto-return type),Over current protection (Auto-return type) loading

■ 4ch Low Drop Out Series Regulator (LDO)
- It has 16 steps selectable output voltage by the register.LDO1, LDO2, LDO3, LDO4: Iomax=150mA

■ Thermal shutdown

■ I^2C BUS FS mode (max 400 kHz) Compatibility

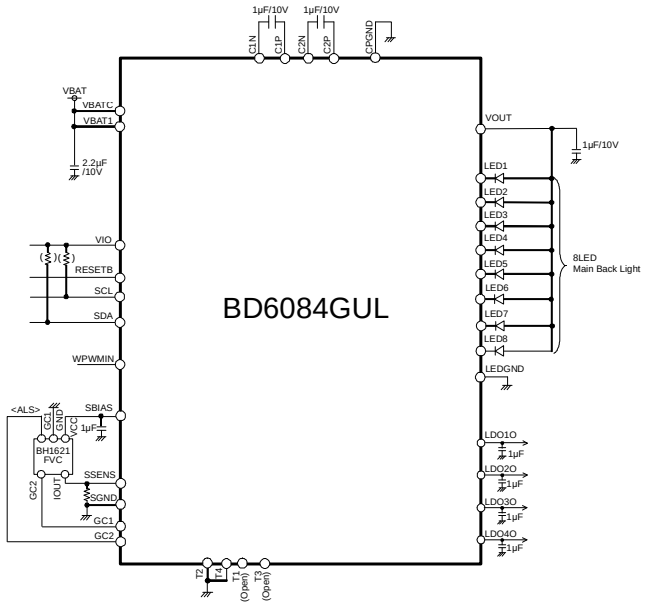
●Key Specification

■ Operating power supply voltage range: 2.7V to 5.5V
■ LED maximum setup current: 25.6mA (Typ.)
■ Switching frequency: 1.0MHz (Typ.)
■ Operating temperature range: -30℃ to +85℃

●Package

W(Typ.) x D(Typ.) x H(Max.)
VCSP50L3 3.15mm x 3.45mm x 0.55mm

●Typical Application Circuit



●Pin Configuration [Bottom View]

	1	2	3	4	5	6
F	T4	GC1	SBIAS	VBAT1	LDO2O	T3
E	SSENS	SGND	LDO4O	SDA	LDO3O	LDO1O
D	LED7	LED8	GC2	SCL	VIO	VOUT
C	LEDGND	LED6	index	C1N	C1P	C2P
B	LED3	LED2	LED5	RESETB	C2N	VBATCP
A	T1	LED1	LED4	WPWMIN	CPGND	T2

○Product structure：Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays

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●**Absolute Maximum Ratings** (Ta=25 ℃)

Parameter	Symbol	Ratings	Unit
Terminal Voltage	VMAX	7	V
Power Dissipation	Pd	1340note)	mW
Operating Temperature Range	Topr	-30 to +85	℃
Storage Temperature Range	Tstg	-55 to +150	℃

note) Power dissipation deleting is 10.72mW/ ℃, when it's used in over 25 ℃. (It's deleting is on the board that is ROHM's standard)

●**Recommended Operating Ratings** (VBAT≥VIO, Ta=-30 to 85℃)

Parameter	Symbol	Limits	Unit
VBAT Input Voltage	VBAT	2.7 to 5.5	V
VIO Pin Voltage	VIO	1.65 to 3.3	V

●**Electrical Characteristics**(Unless otherwise specified, Ta=25℃, VBAT=3.6V, VIO=1.8V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
【Circuit Current】						
VBAT Circuit Current 1	IBAT1	-	0.1	3.0	μA	RESETB=0V, VIO= 0V
VBAT Circuit Current 2	IBAT2	-	0.5	3.0	μA	RESETB=0V, VIO=1.8V
VBAT Circuit Current 3	IBAT3	-	61	65	mA	DC/DC x1 mode, Io=60mA VBAT=4.0V
VBAT Circuit Current 4	IBAT4	-	92	102	mA	DC/DC x1.5 mode, Io=60mA VBAT=3.6V
VBAT Circuit Current 5	IBAT5	-	123	140	mA	DC/DC x2 mode, Io=60mA VBAT=2.7V
VBAT Circuit Current 6	IBAT6	-	0.25	1.0	mA	ALC Operating ALCEN=1, AD cycle=0.5s setting Except sensor current
VBAT Circuit Current 7	IBAT7	-	90	150	μA	LDO1,2=ON, I_{LDO}=0mA
VBAT Circuit Current 8	IBAT8	-	90	150	μA	LDO3,4=ON, I_{LDO}=0mA
【LED Driver】						
LED Current Step (Setup)	ILEDSTP1		128		Step	LED1 to 8
LED Current Step (At Slope)	ILEDSTP2		256		Step	LED1 to 8
LED Maximum Setup Current	IMAXWLED	-	25.6	-	mA	LED1 to 8
LED Current Accuracy	IWLED	-7	-	+7	%	I_{LED}=15mA setting, VLED=1.0V
LED Current Matching	ILEDMT	-	-	4	%	Between LED1 to 8 at VLED=1.0V, I_{LED}=15mA
LED OFF Leak Current	ILKLED	-	-	1.0	μA	VLED=4.5V
【DC/DC(Charge Pump)】						
Output Voltage	VoCP	-	Vf+0.2	Vf+0.25	V	Vf is forward direction of LED
Drive Ability	IOUT	-	-	200	mA	VBAT≥3.2V, VOUT=3.9V
Switching frequency	fosc	0.8	1.0	1.2	MHz	
Over Voltage Protection Detect Voltage	OVP	-	5.6	-	V	
Over Current Protection Detect Current	OCP	-	250	375	mA	VOUT=0V
【Sensor Interface】						
SBIAS Output Voltage	VoS	2.85	3.0	3.15	V	Io=200μA
SBIAS Maximum Output Current	IomaxS	30	-	-	mA	
SBIAS Discharge resistor at OFF	ROFFS	-	1.0	1.5	kΩ	
SSENS Input range	VISS	0	-	VoS × 255/256	V	
ADC resolution	ADRES		8		bit	
ADC INTEGRAL Calculus Non-Linearity	ADINL	-3	-	+3	LSB	
ADC differential Calculus Non-Linearity	ADDNL	-1	-	+1	LSB	

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●**Electrical Characteristics - continued**(Unless otherwise specified, Ta=25℃, VBAT=3.6V, VIO=1.8V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
【Regulator (LDO1)】						
Output voltage	Vo1	1.164	1.20	1.236	V	Io=50mA
		1.261	1.30	1.339	V	Io=50mA
		1.455	1.50	1.545	V	Io=50mA
		1.552	1.60	1.648	V	Io=50mA
		1.746	1.80	1.854	V	Io=50mA <Initial Voltage>
		2.134	2.20	2.266	V	Io=50mA
		2.328	2.40	2.472	V	Io=50mA
		2.425	2.50	2.575	V	Io=50mA
		2.522	2.60	2.678	V	Io=50mA
		2.619	2.70	2.781	V	Io=50mA
		2.716	2.80	2.884	V	Io=50mA
		2.813	2.90	2.987	V	Io=50mA
		2.910	3.00	3.090	V	Io=50mA
		3.007	3.10	3.193	V	Io=50mA
		3.104	3.20	3.296	V	Io=50mA
		3.201	3.30	3.399	V	Io=50mA
Output Current	Io1	-	-	150	mA	Vo=1.8V
Dropout Voltage	Vsat1	-	0.2	0.3	V	VBAT=2.5V, Io=150mA, Vo=2.8V
Load stability	ΔVo11	-	10	60	mV	Io=1 to 150mA, Vo=1.8V
Input voltage stability	ΔVo12	-	10	60	mV	VBAT=3.4 to 4.5V, Io=50mA, Vo=1.8V
Ripple Rejection Ratio	RR1	-	65	-	dB	f=100Hz, Vin=200mVp-p, Vo=1.2V Io=50mA, BW=20Hz to 20kHz
Short circuit current limit	Ilim1	-	200	400	mA	Vo=0V
Discharge resistor at OFF	ROFF1	-	1.0	1.5	kΩ	
【Regulator (LDO2)】						
Output voltage	Vo2	1.164	1.20	1.236	V	Io=50mA
		1.261	1.30	1.339	V	Io=50mA
		1.455	1.50	1.545	V	Io=50mA
		1.552	1.60	1.648	V	Io=50mA
		1.746	1.80	1.854	V	Io=50mA
		2.134	2.20	2.266	V	Io=50mA
		2.328	2.40	2.472	V	Io=50mA
		2.425	2.50	2.575	V	Io=50mA <Initial Voltage>
		2.522	2.60	2.678	V	Io=50mA
		2.619	2.70	2.781	V	Io=50mA
		2.716	2.80	2.884	V	Io=50mA
		2.813	2.90	2.987	V	Io=50mA
		2.910	3.00	3.090	V	Io=50mA
		3.007	3.10	3.193	V	Io=50mA
		3.104	3.20	3.296	V	Io=50mA
		3.201	3.30	3.399	V	Io=50mA
Output Current	Io2	-	-	150	mA	Vo=2.5V
Dropout Voltage	Vsat2	-	0.2	0.3	V	VBAT=2.5V, Io=150mA, Vo=2.8V
Load stability	ΔVo21	-	10	60	mV	Io=1 to 150mA, Vo=2.5V
Input voltage stability	ΔVo22	-	10	60	mV	VBAT=3.4 to 4.5V, Io=50mA, Vo=2.5V
Ripple Rejection Ratio	RR2	-	65	-	dB	f=100Hz, Vin=200mVp-p, Vo=1.2V Io=50mA, BW=20Hz to 20kHz
Short circuit current limit	Ilim2	-	200	400	mA	Vo=0V
Discharge resistor at OFF	ROFF2	-	1.0	1.5	kΩ	

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●**Electrical Characteristics - continued** (Unless otherwise specified, Ta=25℃, VBAT=3.6V, VIO=1.8V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
【Regulator (LDO3)】						
Output voltage	Vo3	1.164	1.20	1.236	V	Io=50mA
		1.261	1.30	1.339	V	Io=50mA
		1.455	1.50	1.545	V	Io=50mA
		1.552	1.60	1.648	V	Io=50mA
		1.746	1.80	1.854	V	Io=50mA <Initial Voltage>
		2.134	2.20	2.266	V	Io=50mA
		2.328	2.40	2.472	V	Io=50mA
		2.425	2.50	2.575	V	Io=50mA
		2.522	2.60	2.678	V	Io=50mA
		2.619	2.70	2.781	V	Io=50mA
		2.716	2.80	2.884	V	Io=50mA
		2.813	2.90	2.987	V	Io=50mA
		2.910	3.00	3.090	V	Io=50mA
		3.007	3.10	3.193	V	Io=50mA
		3.104	3.20	3.296	V	Io=50mA
		3.201	3.30	3.399	V	Io=50mA
Output Current	Io3	-	-	150	mA	Vo=1.8V
Dropout Voltage	Vsat3	-	0.2	0.3	V	VBAT=2.5V, Io=150mA, Vo=2.8V
Load stability	Δvo31	-	10	60	mV	Io=1 to 150mA, Vo=1.8V
Input voltage stability	Δvo32	-	10	60	mV	VBAT=3.4 to 4.5V, Io=50mA, Vo=1.8V
Ripple Rejection Ratio	RR3	-	65	-	dB	f=100Hz, Vin=200mVp-p, Vo=1.2V Io=50mA, BW=20Hz to 20kHz
Short circuit current limit	Ilim3	-	200	400	mA	Vo=0V
Discharge resistor at OFF	ROFF3	-	1.0	1.5	kΩ	
【Regulator (LDO4)】						
Output voltage	Vo4	1.164	1.20	1.236	V	Io=50mA
		1.261	1.30	1.339	V	Io=50mA
		1.455	1.50	1.545	V	Io=50mA
		1.552	1.60	1.648	V	Io=50mA
		1.746	1.80	1.854	V	Io=50mA
		2.134	2.20	2.266	V	Io=50mA
		2.328	2.40	2.472	V	Io=50mA
		2.425	2.50	2.575	V	Io=50mA
		2.522	2.60	2.678	V	Io=50mA
		2.619	2.70	2.781	V	Io=50mA
		2.716	2.80	2.884	V	Io=50mA <Initial Voltage>
		2.813	2.90	2.987	V	Io=50mA
		2.910	3.00	3.090	V	Io=50mA
		3.007	3.10	3.193	V	Io=50mA
		3.104	3.20	3.296	V	Io=50mA
		3.201	3.30	3.399	V	Io=50mA
Output Current	Io4	-	-	150	mA	Vo=2.8V
Dropout Voltage	Vsat4	-	0.2	0.3	V	VBAT=2.5V, Io=150mA, Vo=2.8V
Load stability	Δvo41	-	10	60	mV	Io=1 to 150mA, Vo=2.8V
Input voltage stability	Δvo42	-	10	60	mV	VBAT=3.4 to 4.5V, Io=50mA, Vo=2.8V
Ripple Rejection Ratio	RR4	-	65	-	dB	f=100Hz, Vin=200mVp-p, Vo=1.2V Io=50mA, BW=20Hz to 20kHz
Short circuit current limit	Ilim4	-	200	400	mA	Vo=0V
Discharge resistor at OFF	ROFF4	-	1.0	1.5	kΩ	

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●**Electrical Characteristics - continued** (Unless otherwise specified, Ta=25℃, VBAT=3.6V, VIO=1.8V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
【SDA, SCL】(I^2C Interface)						
L level input voltage	VILI	-0.3	-	0.25×VIO	V	
H level input voltage	VIHI	0.75×VIO	-	VBAT+0.3	V	
Hysteresis of Schmitt trigger input	VhysI	0.05 ×VIO	-	-	V	
L level output voltage	VOLI	0	-	0.3	V	SDA Pin, IOL=3 mA
Input current	IinI	-	-	1	μA	Input Voltage= 0.1×VIO to 0.9×VIO
【WPWMIN】(NMOS Input Pin)						
L level input voltage	VILA	-0.3	-	0.3	V	
H level input voltage	VIHA	1.4	-	VBAT+0.3	V	
Input Current	IinA	-	3.6	10	μA	Input Voltage = 1.8V
PWM input minimum High pulse width	PWmin	250	-	-	μs	WPWMIN Pin
【GC1, GC2】(Sensor Gain Control CMOS Output Pin)						
L level output voltage	VOLS	-	-	0.2	V	IOL=1mA
H level output voltage	VOHS	VoS-0.2	-	-	V	IOH=1mA

Parameter	Symbol	Standard-mode			Fast-mode			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
【I^2C BUS format】								
SCL clock frequency	f_{SCL}	0	-	100	0	-	400	kHz
LOW period of the SCL clock	t_{LOW}	4.7	-	-	1.3	-	-	μs
HIGH period of the SCL clock	t_{HIGH}	4.0	-	-	0.6	-	-	μs
Hold time (repeated) START condition After this period, the first clock is generated	$t_{HD;STA}$	4.0	-	-	0.6	-	-	μs
Set-up time for a repeated START condition	$t_{SU;STA}$	4.7	-	-	0.6	-	-	μs
Data hold time	$t_{HD;DAT}$	0	-	3.45	0	-	0.9	μs
Data set-up time	$t_{SU;DAT}$	250	-	-	100	-	-	ns
Set-up time for STOP condition	$t_{SU;STO}$	4.0	-	-	0.6	-	-	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	-	1.3	-	-	μs

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●**Pin Descriptions**

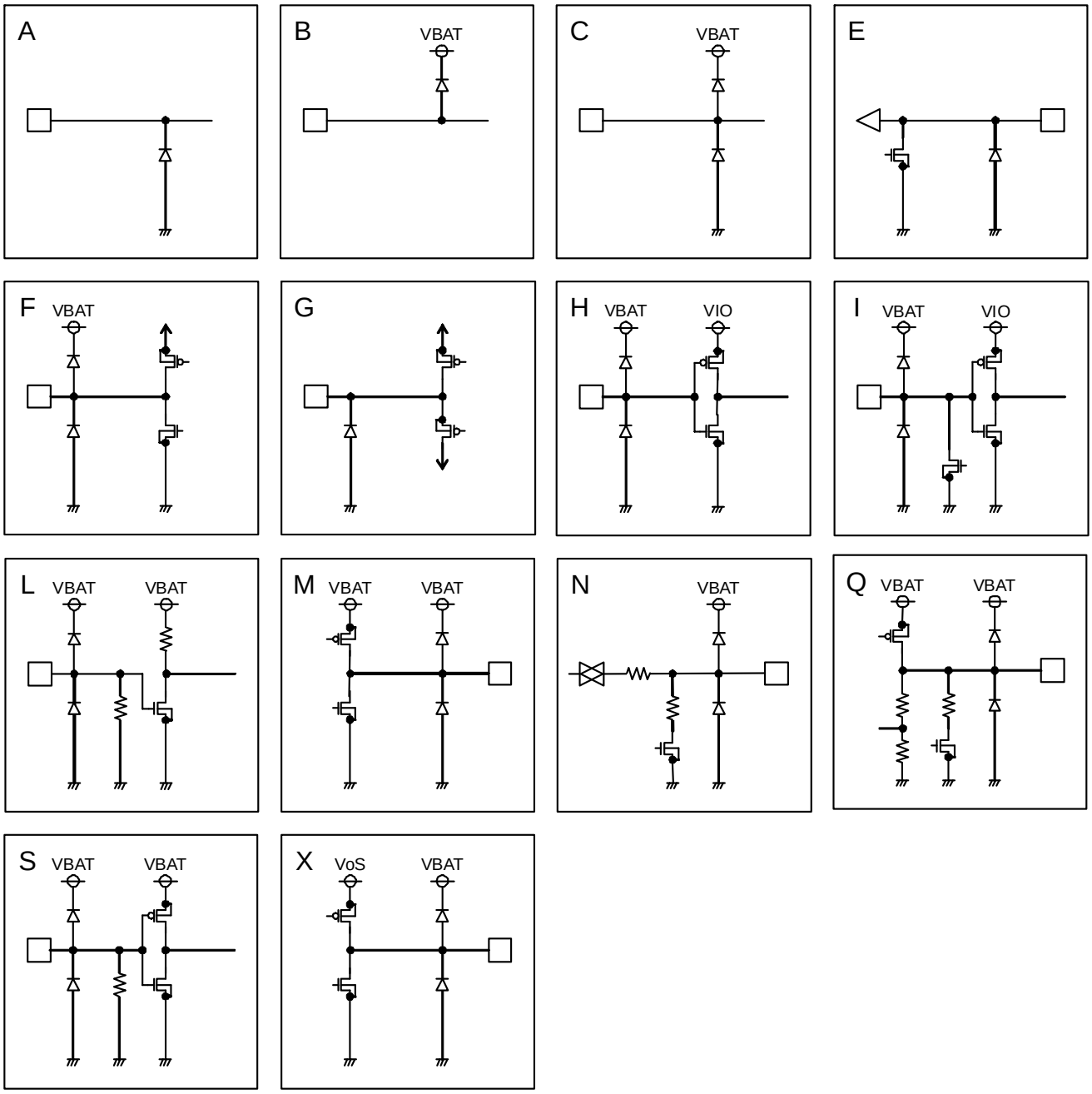
No	Ball No.	Pin Name	I/O	ESD Diode		Functions	Equivalent Circuit
				For Power	For Ground		
1	B6	VBATCP	-	-	GND	Battery is connected	A
2	F4	VBAT1	-	-	GND	Battery is connected	A
3	A1	T1	O	VBAT	GND	Test Output Pin (Open)	N
4	A6	T2	I	VBAT	GND	Test Input Pin (short to Ground)	S
5	F6	T3	O	VBAT	GND	Test Output Pin(Open)	M
6	F1	T4	I	VBAT	GND	Test Input Pin (short to Ground)	S
7	D5	VIO	-	VBAT	GND	I/O Power supply is connected	C
8	E4	SDA	I/O	VBAT	GND	I^2C data input / output	I
9	D4	SCL	I	VBAT	GND	I^2C clock input	H
10	A5	CPGND	-	VBAT	-	Ground	B
11	B4	RESETB	I	VBAT	GND	Reset Input (L:Reset, H:Reset Cancel)	H
12	C1	LEDGND	-	VBAT	-	Ground	B
13	C4	C1N	I/O	VBAT	GND	Charge Pump capacitor is connected	F
14	C5	C1P	I/O	-	GND	Charge Pump capacitor is connected	G
15	B5	C2N	I/O	VBAT	GND	Charge Pump capacitor is connected	F
16	C6	C2P	I/O	-	GND	Charge Pump capacitor is connected	G
17	D6	VOUT	O	-	GND	Charge Pump output pin	A
18	A2	LED1	I	-	GND	LED is connected 1 for LCD Back Light	E
19	B2	LED2	I	-	GND	LED is connected 2 for LCD Back Light	E
20	B1	LED3	I	-	GND	LED is connected 3 for LCD Back Light	E
21	A3	LED4	I	-	GND	LED is connected 4 for LCD Back Light	E
22	B3	LED5	I	-	GND	LED is connected 5 for LCD Back Light	E
23	C2	LED6	I	-	GND	LED is connected 6 for LCD Back Light	E
24	D1	LED7	I	-	GND	LED is connected 7 for LCD Back Light	E
25	D2	LED8	I	-	GND	LED is connected 8 for LCD Back Light	E
26	F3	SBIAS	O	VBAT	GND	Bias output for the Ambient Light Sensor	Q
27	E1	SSENS	I	VBAT	GND	Ambient Light Sensor input	N
28	F2	GC1	O	VBAT	GND	Ambient Light Sensor gain control output 1	X
29	D3	GC2	O	VBAT	GND	Ambient Light Sensor gain control output 2	X
30	E2	SGND	-	VBAT	-	Ground	B
31	A4	WPWMIN	I	VBAT	GND	External PWM input for Back Light *	L
32	E6	LDO1O	O	VBAT	GND	LDO1 output pin	Q
33	F5	LDO2O	O	VBAT	GND	LDO2 output pin	Q
34	E5	LDO3O	O	VBAT	GND	LDO3 output pin	Q
35	E3	LDO4O	O	VBAT	GND	LDO4 output pin	Q

* A setup of a register is separately necessary to make it effective.

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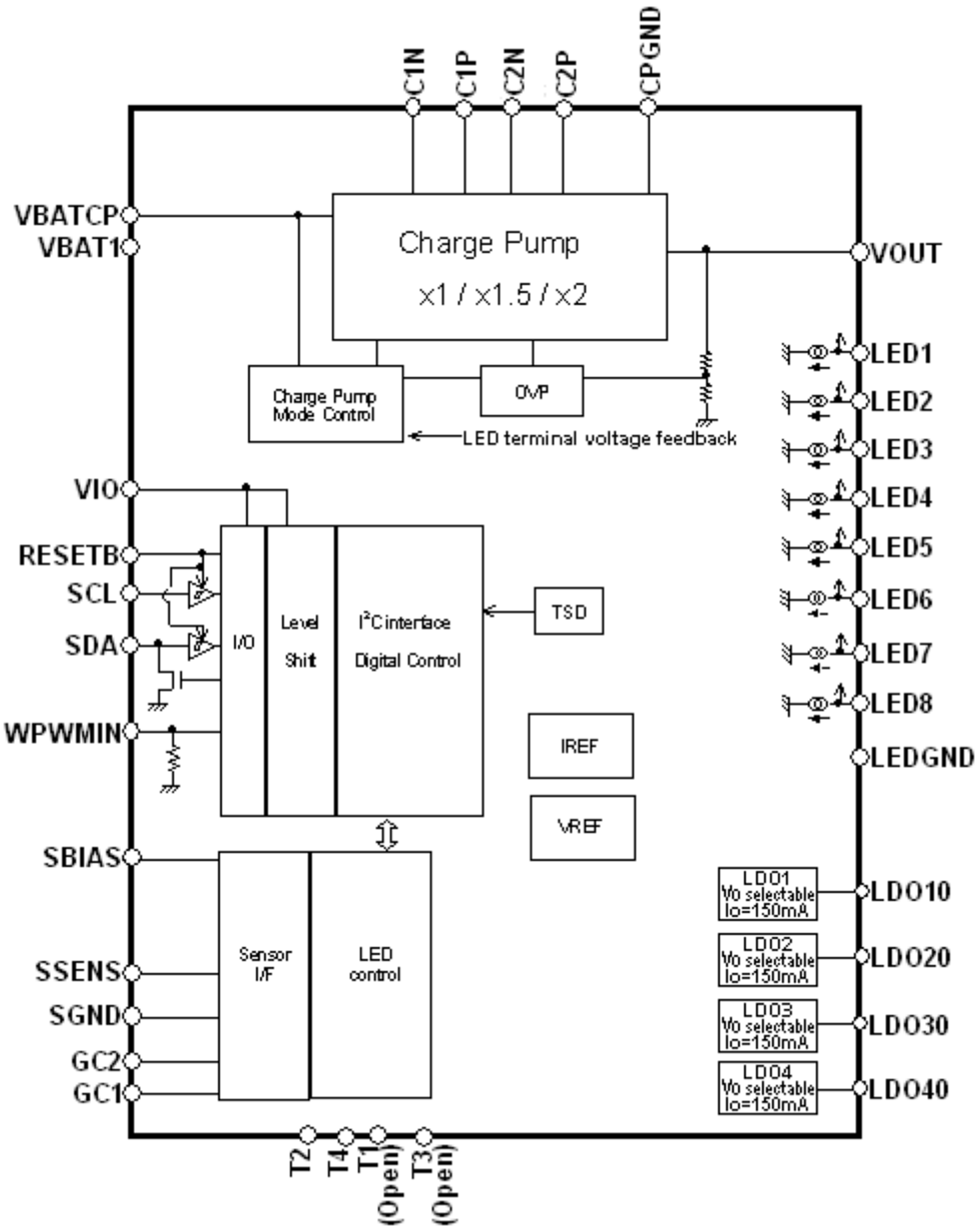
●**Pin ESD Type**



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●**Block Diagram**



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●I²C BUS Format

The writing/reading operation is based on the I²C slave standard.

・Slave address

A7	A6	A5	A4	A3	A2	A1	R/W
1	1	1	0	1	1	0	1/0

・Bit Transfer

SCL transfers 1-bit data during H. SCL cannot change signal of SDA during H at the time of bit transfer. If SDA changes while SCL is H, START conditions or STOP conditions will occur and it will be interpreted as a control signal.

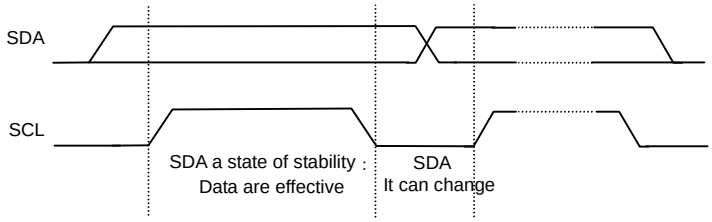


Figure 1.

・START and STOP condition

When SDA and SCL are H, data is not transferred on the I²C- bus. This condition indicates, if SDA changes from H to L while SCL has been H, it will become START (S) conditions, and an access start, if SDA changes from L to H while SCL has been H, it will become STOP (P) conditions and an access end.

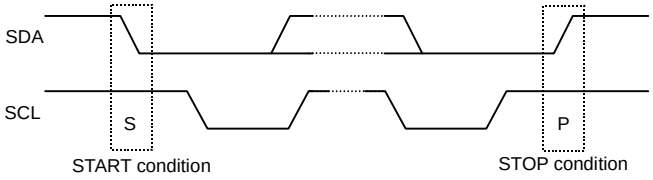


Figure 2.

・Acknowledge

It transfers data 8 bits each after the occurrence of START condition. A transmitter opens SDA after transfer 8bits data, and a receiver returns the acknowledge signal by setting SDA to L.

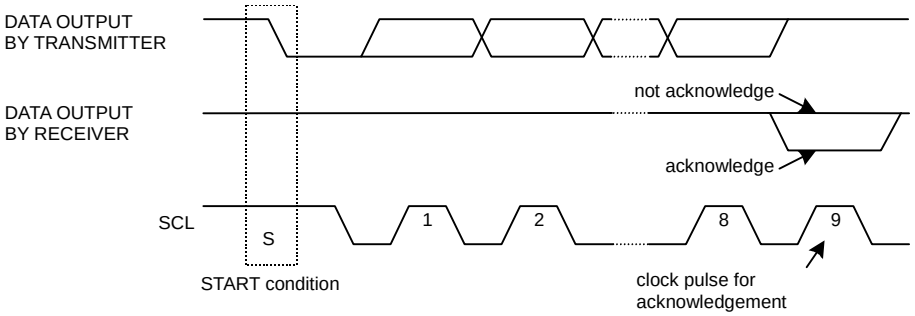


Figure 3.

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・Writing protocol

A register address is transferred by the next 1 byte that transferred the slave address and the write-in command.
The 3rd byte writes data in the internal register written in by the 2nd byte, and after 4th byte or, the increment of register address is carried out automatically. However, when a register address turns into the last address, it is set to 00h by the next transmission. After the transmission end, the increment of the address is carried out.

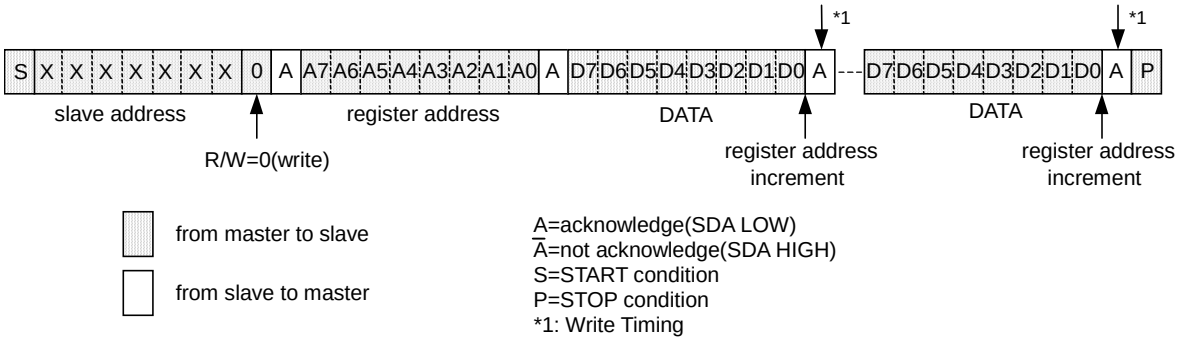


Figure 4.

・Reading protocol

It reads from the next byte after writing a slave address and R/W bit. The register to read considers as the following address accessed at the end, and the data of the address that carried out the increment is read after it. If an address turns into the last address, the next byte will read out 00h. After the transmission end, the increment of the address is carried out.

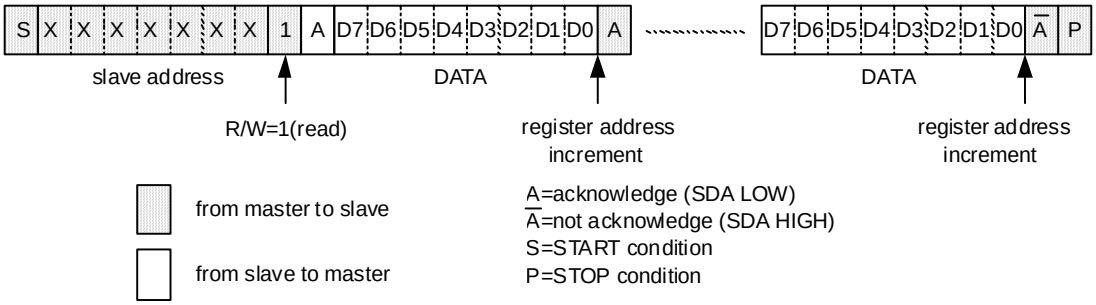


Figure 5.

・Multiple reading protocols

After specifying an internal address, it reads by repeated START condition and changing the data transfer direction. The data of the address that carried out the increment is read after it. If an address turns into the last address, the next byte will read out 00h. After the transmission end, the increment of the address is carried out.

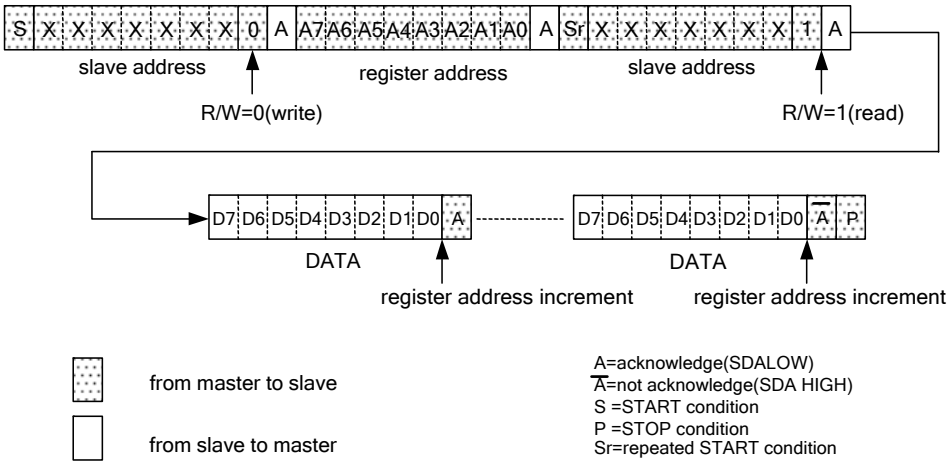


Figure 6.

As for reading protocol and multiple reading protocols, please do Ā(not acknowledge) after doing the final reading operation. It stops with read when ending by A(acknowledge), and SDA stops in the state of Low when the reading data of that time is 0. However, this state returns usually when SCL is moved, data is read, and Ā (not acknowledge) is done.

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●**Timing Diagram**

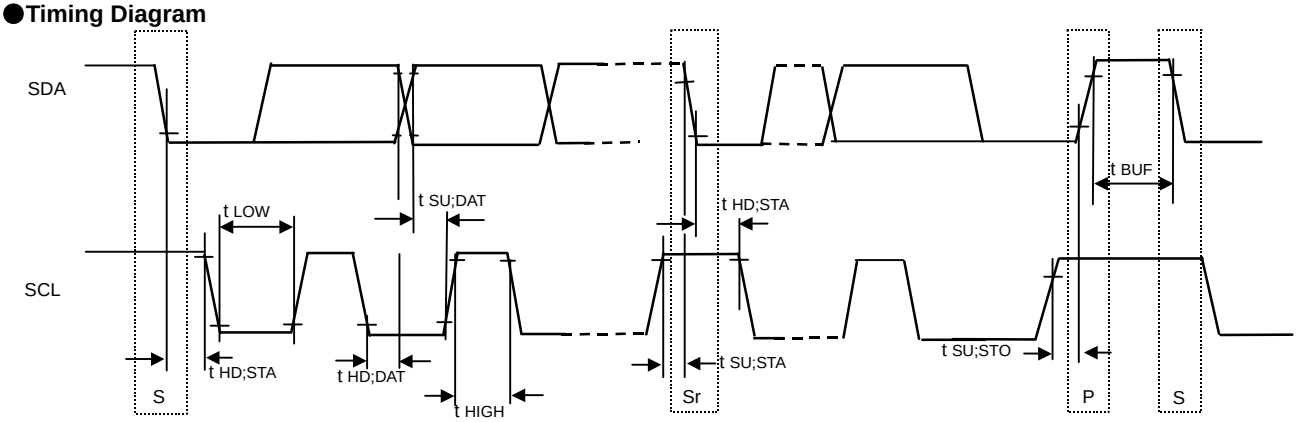


Figure 7.

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●Register List

Address	W/R	Register data								Function
		D7	D6	D5	D4	D3	D2	D1	D0	
00h	W	-	-	-	-	-	-	-	SFTRST	Software Reset
01h	W	-	-	W8MD	W7MD	W6MD	W5MD	W4MD	MLEDMD	LED Pin function setting
02h	W	WPWMEN	ALCEN	W8EN	W7EN	W6EN	W5EN	-	MLEDEN	LED Power Control
03h	W	-	IMLED(6)	IMLED(5)	IMLED(4)	IMLED(3)	IMLED(2)	IMLED(1)	IMLED(0)	Main group current setting
04h	-	-	-	-	-	-	-	-	-	
05h	W	-	IW5(6)	IW5(5)	IW5(4)	IW5(3)	IW5(2)	IW5(1)	IW5(0)	LED5 current setting
06h	W	-	IW6(6)	IW6(5)	IW6(4)	IW6(3)	IW6(2)	IW6(1)	IW6(0)	LED6 current setting
07h	W	-	IW7(6)	IW7(6)	IW7(6)	IW7(6)	IW7(6)	IW7(6)	IW7(6)	LED7 current setting
08h	W	-	IW8(6)	IW8(6)	IW8(6)	IW8(6)	IW8(6)	IW8(6)	IW8(6)	LED8 current setting
09h	W	THL (3)	THL (2)	THL (1)	THL (0)	TLH (3)	TLH (2)	TLH (1)	TLH (0)	Main Current transition
0Ah	W	-	ADCYC	-	GAIN	STYPE	-	MDCIR	SBIASON	Measurement mode setting
0Bh	W	-	-	-	-	CRV	STEP (2)	STEP (1)	STEP (0)	ALC Slope curve setup
0Ch	R	-	-	-	-	AMB (3)	AMB (2)	AMB (1)	AMB (0)	Ambient level
0Dh	W	-	IU0 (6)	IU0 (5)	IU0 (4)	IU0 (3)	IU0 (2)	IU0 (1)	IU0 (0)	LED Current at Ambient level 0h (ALC)
0Eh	W	-	IU1 (6)	IU1 (5)	IU1 (4)	IU1 (3)	IU1 (2)	IU1 (1)	IU1 (0)	LED Current max (ALC)
0Fh	-	-	-	-	-	-	-	-	-	
10h	-	-	-	-	-	-	-	-	-	
11h	-	-	-	-	-	-	-	-	-	
12h	-	-	-	-	-	-	-	-	-	
13h	W	-	-	-	-	LDO4EN	LDO3EN	LDO2EN	LDO1EN	LDO Power Control
14h	W	LDO2VSEL3	LDO2VSEL2	LDO2VSEL1	LDO2VSEL0	LDO1VSEL3	LDO1VSEL2	LDO1VSEL1	LDO1VSEL0	LDO1 Vout Control LDO2 Vout Control
15h	W	LDO4VSEL3	LDO4VSEL2	LDO4VSEL1	LDO4VSEL0	LDO3VSEL3	LDO3VSEL2	LDO3VSEL1	LDO3VSEL0	LDO3 Vout Control LDO4 Vout Control

Input "0" for "-".
Prohibit to accessing the address that isn't mentioned.

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●**Register Map**

Address 00h < Software Reset >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
00h	W	-	-	-	-	-	-	-	SFTRST
Initial Value	00h	-	-	-	-	-	-	-	0

Bit[7:1] : (Not used)

Bit0 : **SFTRST** Software Reset
"0" : Reset cancel
"1" : Reset(All register initializing)
Refer to page 27 "Reset" for detail.

Address 01h < LED Pin function setting>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
01h	W	-	-	W8MD	W7MD	W6MD	W5MD	W4MD	MLEDMD
Initial Value	02h	-	-	0	0	0	0	1	0

Bit[7:6] : (Not used)

Bit5 : **W8MD** LED8 control setting (individual / Main group)
"0" : LED8 individual control (Initial Value)
"1" : LED8 Main group control
Refer to page 29 "LED Driver" for detail.

Bit4 : **W7MD** LED7 control setting (individual / Main group)
"0" : LED7 individual control (Initial Value)
"1" : LED7 Main group control
Refer to page 29 "LED Driver" for detail.

Bit3 : **W6MD** LED6 control setting (individual / Main group)
"0" : LED6 individual control (Initial Value)
"1" : LED6 Main group control
Refer to page 29 "LED Driver" for detail.

Bit2 : **W5MD** LED5 control setting (individual / Main group)
"0" : LED5 individual control (Initial Value)
"1" : LED5 Main group control
Refer to page 29 "LED Driver" for detail.

Bit1 : **W4MD** LED4 Control Board setting (unuse / use)
"0" : LED4 unuse
"1" : LED4 use (Main group Control) (Initial Value)
Refer to page 29 "LED Driver" for detail.

Bit0 : **MLEDMD** Main group setting (Normal / ALC)
"0" : Main group Normal Mode(ALCNon-reflection)(Initial Value)
"1" : Main group ALC Mode
Refer to page 31 "(1) Auto Luminous Control ON/OFF" of "ALC" for detail.

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Address 02h < LED Power Control>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
02h	W	WPWMEN	ALCEN	W8EN	W7EN	W6EN	W5EN	-	MLEDEN
Initial Value	00h	0	0	0	0	0	0	0	0

Bit7 : **WPWMEN** External PWM Input “WPWMIN” terminal Enable Control (Valid/Invalid)
“0” : External PWM input invalid (Initial Value)
“1” : External PWM input valid
Refer to “(10) Current Adjustment” of “ALC” for detail.

Bit6 : **ALCEN** ALC function Control (ON/OFF)
“0” : ALC block OFF (Initial Value)
“1” : ALC block ON (Ambient Measurement)
Refer to “(1) Auto Luminous Control ON/OFF” of “ALC” for detail.

Bit5 : **W8EN** LED8 Control (ON/OFF)
“0” : LED8 OFF (Initial Value)
“1” : LED8 ON(individual control)

Bit4 : **W7EN** LED7 Control (ON/OFF)
“0” : LED7 OFF (Initial Value)
“1” : LED7 ON(individual control)

Bit3 : **W6EN** LED6 Control (ON/OFF)
“0” : LED6 OFF (Initial Value)
“1” : LED6 ON(individual control)

Bit2 : **W5EN** LED5 Control (ON/OFF)
“0” : LED5 OFF (Initial Value)
“1” : LED5 ON(individual control)

Bit1 : (Not used)

Bit0 : **MLEDEN** Main group LED Control (ON/OFF)
“0” : Main group OFF (Initial Value)
“1” : Main group ON

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Address 03h < Main group LED Current setting(Normal Mode) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
03h	W	-	IMLED(6)	IMLED(5)	IMLED(4)	IMLED(3)	IMLED(2)	IMLED(1)	IMLED(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (Not used)

Bit[6:0] : **IMLED (6:0)** Main Group LED Current Setting at non-ALC mode

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 05h < LED5 Current setting(Independence control) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
05h	W	-	IW5(6)	IW5(5)	IW5(4)	IW5(3)	IW5(2)	IW5(1)	IW5(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (Not used)

Bit[6:0] : **IW5 (6:0)** LED5 Current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 06h < LED6 Current setting(Independence control) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
06h	W	-	IW6(6)	IW6(5)	IW6(4)	IW6(3)	IW6(2)	IW6(1)	IW6(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (Not used)

Bit[6:0] : **IW6 (6:0)** LED6 Current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 07h < LED7 Current setting(Independence control) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
07h	W	-	IW7(6)	IW7(5)	IW7(4)	IW7(3)	IW7(2)	IW7(1)	IW7(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (Not used)

Bit[6:0] : **IW7 (6:0)** LED7 Current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 08h < LED8 Current setting(Independence control) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
08h	W	-	IW8(6)	IW8(5)	IW8(4)	IW8(3)	IW8(2)	IW8(1)	IW8(0)
Initial Value	00h	-	0	0	0	0	0	0	0

Bit7 : (Not used)

Bit[6:0] : **IW8 (6:0)** LED8 Current setting

“0000000” :	0.2 mA (Initial Value)	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 09h < Main Current slope time setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
09h	W	THL(3)	THL(2)	THL(1)	THL(0)	TLH(3)	TLH(2)	TLH(1)	TLH(0)
Initial Value	C7h	1	1	0	0	0	1	1	1

Bit[7:4] : **THL (3:0)** Main LED current Down transition per 0.2mA step
"0000" : 0.256 ms
"0001" : 0.512 ms
"0010" : 1.024 ms
"0011" : 2.048 ms
"0100" : 4.096 ms
"0101" : 8.192 ms
"0110" : 16.38 ms
"0111" : 32.77 ms
"1000" : 65.54 ms
"1001" : 131.1 ms
"1010" : 196.6 ms
"1011" : 262.1 ms
"1100" : 327.7 ms (Initial Value)
"1101" : 393.2 ms
"1110" : 458.8 ms
"1111" : 524.3 ms
Setting time is counted based on the switching frequency of Charge Pump.
The above value becomes the value of the Typ (1MHz) time.
Refer to "(8) Slope Process" of "ALC" for detail.

Bit[3:0] : TLH (3:0) Main LED current up transition per 0.2mA step
"0000" : 0.256 ms
"0001" : 0.512 ms
"0010" : 1.024 ms
"0011" : 2.048 ms
"0100" : 4.096 ms
"0101" : 8.192 ms
"0110" : 16.38 ms
"0111" : 32.77 ms (Initial Value)
"1000" : 65.54 ms
"1001" : 131.1 ms
"1010" : 196.6 ms
"1011" : 262.1 ms
"1100" : 327.7 ms
"1101" : 393.2 ms
"1110" : 458.8 ms
"1111" : 524.3 ms
Setting time is counted based on the switching frequency of Charge Pump.
The above value becomes the value of the Typ (1MHz) time.
Refer to "(8) Slope Process" of "ALC" for detail.

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Address 0Ah < ALC mode setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Ah	W	-	ADCYC	-	GAIN	STYPE	-	MDCIR	SBIASON
Initial Value	01h	-	0	-	0	0	-	0	1

Bit7 : (Not used)

Bit6 : **ADCYC** ADC Measurement Cycle
"0" : 0.52 s (Initial Value)
"1" : 1.05 s
Refer to "(4) A/D conversion" of "ALC" for detail.

Bit5 : (Not used)

Bit4 : **GAIN** Sensor Gain Switching Function Control
"0" : Auto Change (Initial Value)
"1" : Fixed
Refer to "(3) Gain control" of "ALC" for detail.

Bit3 : **STYPE** Sensor type selection (Linear output/ Log output)
"0" : Linear output type (Initial Value)
"1" : Log output type
Refer to "(6) Ambient level detection" for detail.

Bit2 : (Not used)

Bit1 : **MDCIR** LED Current Reset Select by Mode Change
"0" : LED current non-reset when mode change (Initial Value)
"1" : LED current reset when mode change
Refer to "(9) LED current reset when mode change" of "ALC" for detail.

Bit0 : **SBIASON**
"0" : Measurement cycle synchronous
"1" : Usually ON (at ALCEN=1) (Initial Value)
Refer to "(4) A/D conversion" of "ALC" for detail.

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Address 0Bh < ALC slope curve setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Bh	W	-	-	-	-	CRV	STEP (2)	STEP (1)	STEP (0)
Initial Value	01h	-	-	-	-	0	0	0	1

Bit[7:4] : (Not used)

Bit3 : **CRV** Brightness Current Conversion Curve Type
"0" Log curve (Initial Value)
"1" linear

Bit[2:0] : **STEP (2:0)** Step At the time of Brightness Current Conversion
"000" : 1.0mA
"001" : 1.1mA (Initial Value)
"010" : 1.2mA
"011" : 1.3mA
"100" : 1.6mA
"101" : 1.7mA
"110" : 1.8mA
"111" : 1.9mA

Refer to "(7) Convert LED Current" of "ALC" for detail.

Address 0Ch < Ambient level (Read Only) >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Ch	R	-	-	-	-	AMB(3)	AMB(2)	AMB(1)	AMB(0)
Initial Value	(00h)	-	-	-	-	(0)	(0)	(0)	(0)

Bit[7:4] : (Not used)

Bit[3:0] : **AMB (3:0)** Ambient Level
"0000" : 0h (Initial Value)
"0001" : 1h
"0010" : 2h
"0011" : 3h
"0100" : 4h
"0101" : 5h
"0110" : 6h
"0111" : 7h
"1000" : 8h
"1001" : 9h
"1010" : Ah
"1011" : Bh
"1100" : Ch
"1101" : Dh
"1110" : Eh
"1111" : Fh

It begins to read Ambient data through I^2C, and possible.
To the first AD measurement completion, it is AMB(3:0)=0000.
Refer to "(6) Ambient level detection" of "ALC" for detail.

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Address 0Dh < Ambient LED Current setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Dh	W	-	IU0 (6)	IU0 (5)	IU0 (4)	IU0 (3)	IU0 (2)	IU0 (1)	IU0 (0)
Initial Value	13	-	0	0	1	0	0	1	1

Bit7 : (Not used)

Bit[6:0] : **IU0(6:0)** Main Current at Ambient Level for 0h

“0000000” :	0.2 mA	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA (Initial Value)	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 0Eh < LED Max Current setting >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0Eh	W	-	IU1 (6)	IU1 (5)	IU1 (4)	IU1 (3)	IU1 (2)	IU1 (1)	IU1 (0)
Initial Value	63h	-	1	1	0	0	0	1	1

Bit7 : (Not used)

Bit[6:0] : **IU1 (6:0)** LED Max Current (for ALC)

“0000000” :	0.2 mA	“1000000” :	13.0 mA
“0000001” :	0.4 mA	“1000001” :	13.2 mA
“0000010” :	0.6 mA	“1000010” :	13.4 mA
“0000011” :	0.8 mA	“1000011” :	13.6 mA
“0000100” :	1.0 mA	“1000100” :	13.8 mA
“0000101” :	1.2 mA	“1000101” :	14.0 mA
“0000110” :	1.4 mA	“1000110” :	14.2 mA
“0000111” :	1.6 mA	“1000111” :	14.4 mA
“0001000” :	1.8 mA	“1001000” :	14.6 mA
“0001001” :	2.0 mA	“1001001” :	14.8 mA
“0001010” :	2.2 mA	“1001010” :	15.0 mA
“0001011” :	2.4 mA	“1001011” :	15.2 mA
“0001100” :	2.6 mA	“1001100” :	15.4 mA
“0001101” :	2.8 mA	“1001101” :	15.6 mA
“0001110” :	3.0 mA	“1001110” :	15.8 mA
“0001111” :	3.2 mA	“1001111” :	16.0 mA
“0010000” :	3.4 mA	“1010000” :	16.2 mA
“0010001” :	3.6 mA	“1010001” :	16.4 mA
“0010010” :	3.8 mA	“1010010” :	16.6 mA
“0010011” :	4.0 mA	“1010011” :	16.8 mA
“0010100” :	4.2 mA	“1010100” :	17.0 mA
“0010101” :	4.4 mA	“1010101” :	17.2 mA
“0010110” :	4.6 mA	“1010110” :	17.4 mA
“0010111” :	4.8 mA	“1010111” :	17.6 mA
“0011000” :	5.0 mA	“1011000” :	17.8 mA
“0011001” :	5.2 mA	“1011001” :	18.0 mA
“0011010” :	5.4 mA	“1011010” :	18.2 mA
“0011011” :	5.6 mA	“1011011” :	18.4 mA
“0011100” :	5.8 mA	“1011100” :	18.6 mA
“0011101” :	6.0 mA	“1011101” :	18.8 mA
“0011110” :	6.2 mA	“1011110” :	19.0 mA
“0011111” :	6.4 mA	“1011111” :	19.2 mA
“0100000” :	6.6 mA	“1100000” :	19.4 mA
“0100001” :	6.8 mA	“1100001” :	19.6 mA
“0100010” :	7.0 mA	“1100010” :	19.8 mA
“0100011” :	7.2 mA	“1100011” :	20.0 mA (Initial Value)
“0100100” :	7.4 mA	“1100100” :	20.2 mA
“0100101” :	7.6 mA	“1100101” :	20.4 mA
“0100110” :	7.8 mA	“1100110” :	20.6 mA
“0100111” :	8.0 mA	“1100111” :	20.8 mA
“0101000” :	8.2 mA	“1101000” :	21.0 mA
“0101001” :	8.4 mA	“1101001” :	21.2 mA
“0101010” :	8.6 mA	“1101010” :	21.4 mA
“0101011” :	8.8 mA	“1101011” :	21.6 mA
“0101100” :	9.0 mA	“1101100” :	21.8 mA
“0101101” :	9.2 mA	“1101101” :	22.0 mA
“0101110” :	9.4 mA	“1101110” :	22.2 mA
“0101111” :	9.6 mA	“1101111” :	22.4 mA
“0110000” :	9.8 mA	“1110000” :	22.6 mA
“0110001” :	10.0 mA	“1110001” :	22.8 mA
“0110010” :	10.2 mA	“1110010” :	23.0 mA
“0110011” :	10.4 mA	“1110011” :	23.2 mA
“0110100” :	10.6 mA	“1110100” :	23.4 mA
“0110101” :	10.8 mA	“1110101” :	23.6 mA
“0110110” :	11.0 mA	“1110110” :	23.8 mA
“0110111” :	11.2 mA	“1110111” :	24.0 mA
“0111000” :	11.4 mA	“1111000” :	24.2 mA
“0111001” :	11.6 mA	“1111001” :	24.4 mA
“0111010” :	11.8 mA	“1111010” :	24.6 mA
“0111011” :	12.0 mA	“1111011” :	24.8 mA
“0111100” :	12.2 mA	“1111100” :	25.0 mA
“0111101” :	12.4 mA	“1111101” :	25.2 mA
“0111110” :	12.6 mA	“1111110” :	25.4 mA
“0111111” :	12.8 mA	“1111111” :	25.6 mA

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Address 13h <LDO Power Control>

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
13h	W/R	-	-	-	-	LDO4EN	LDO3EN	LDO2EN	LDO1EN
Initial Value	00h	-	-	-	-	0	0	0	0

Bit[7:4] : (Not used)

Bit3 : **LDO4EN** LDO4 control (ON/OFF)
"0" : LDO4 OFF (Initial Value)
"1" : LDO4 ON

Bit2 : **LDO3EN** LDO3 control (ON/OFF)
"0" : LDO3 OFF (Initial Value)
"1" : LDO3 ON

Bit1 : **LDO2EN** LDO2 control (ON/OFF)
"0" : LDO2 OFF (Initial Value)
"1" : LDO2 ON

Bit0 : **LDO1EN** LDO1 control (ON/OFF)
"0" : LDO1 OFF (Initial Value)
"1" : LDO1 ON

Address 14h < LDO1 Vout Control, LDO2 Vout Control >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
14h	R/W	LDO2VSEL3	LDO2VSEL 2	LDO2VSEL 1	LDO2VSEL 0	LDO1VSEL 3	LDO1VSEL 2	LDO1VSEL 1	LDO1VSEL 0
Initial Value	74h	0	1	1	1	0	1	0	0

Bit[7:4] : LDO2VSEL [3:0]
"0000" : 1.20 V
"0001" : 1.30 V
"0010" : 1.50 V
"0011" : 1.60 V
"0100" : 1.80 V
"0101" : 2.20 V
"0110" : 2.40 V
"0111" : 2.50 V (Initial Value)
"1000" : 2.60 V
"1001" : 2.70 V
"1010" : 2.80 V
"1011" : 2.90 V
"1100" : 3.00 V
"1101" : 3.10 V
"1110" : 3.20 V
"1111" : 3.30 V

Bit[3:0] : LDO1VSEL [3:0]
"0000" : 1.20 V
"0001" : 1.30 V
"0010" : 1.50 V
"0011" : 1.60 V
"0100" : 1.80 V (Initial Value)
"0101" : 2.20 V
"0110" : 2.40 V
"0111" : 2.50 V
"1000" : 2.60 V
"1001" : 2.70 V
"1010" : 2.80 V
"1011" : 2.90 V
"1100" : 3.00 V
"1101" : 3.10 V
"1110" : 3.20 V
"1111" : 3.30 V

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Address 15h < LDO3 Vout Control, LDO4 Vout Control >

Address	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
15h	R/W	LDO4VSEL3	LDO4VSEL 2	LDO4VSEL 1	LDO4VSEL 0	LDO3VSEL 3	LDO3VSEL 2	LDO3VSEL 1	LDO3VSEL 0
Initial Value	A4h	1	0	1	0	0	1	0	0

Bit[7:4] : LDO4VSEL [3:0]

"0000" : 1.20 V
"0001" : 1.30 V
"0010" : 1.50 V
"0011" : 1.60 V
"0100" : 1.80 V
"0101" : 2.20 V
"0110" : 2.40 V
"0111" : 2.50 V
"1000" : 2.60 V
"1001" : 2.70 V
"1010" : 2.80 V (Initial Value)
"1011" : 2.90 V
"1100" : 3.00 V
"1101" : 3.10 V
"1110" : 3.20 V
"1111" : 3.30 V

Bit[3:0] : LDO3VSEL [3:0]

"0000" : 1.20 V
"0001" : 1.30 V
"0010" : 1.50 V
"0011" : 1.60 V
"0100" : 1.80 V (Initial Value)
"0101" : 2.20 V
"0110" : 2.40 V
"0111" : 2.50 V
"1000" : 2.60 V
"1001" : 2.70 V
"1010" : 2.80 V
"1011" : 2.90 V
"1100" : 3.00 V
"1101" : 3.10 V
"1110" : 3.20 V
"1111" : 3.30 V

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●Reset

There are two kinds of reset, software reset and hardware reset

(1)Software reset

- All the registers are initialized by SFTRST="1".
- SFTRST is an automatically returned to "0". (Auto Return 0).

(2)Hardware reset

- It shifts to hardware reset by changing RESETB pin “H” → “L”.
- The condition of all the registers under hardware reset pin is returned to the Initial Value, and it stops accepting all address.
- It’s possible to release from a state of hardware reset by changing RESETB pin “L” → “H”.
- RESETB pin has delay circuit. It doesn’t recognize as hardware reset in “L” period under 5μs.

(3)Reset Sequence

- When hardware reset was done during software reset, software reset is canceled when hardware reset is canceled. (Because the Initial Value of software reset is “0”)

●VIODET

The decline of the VIO voltage is detected, and faulty operation inside the IC is prevented by giving resetting to Levelsift block

Image Block Diagram

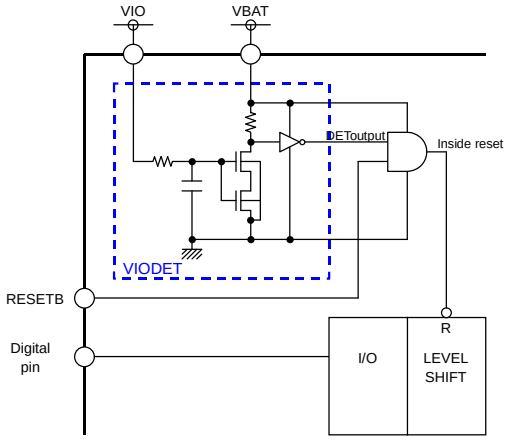


Figure 8.

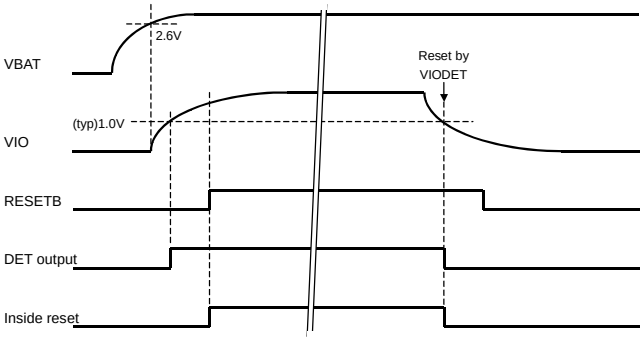


Figure 9.

When the VIO voltage becomes more than typ1.0V(Vth of NMOS in the IC), VIODET is removed.
On the contrary, when VIO is as follows 1.0V, it takes reset.(The VBAT voltage being a prescribed movement range)

●Thermal Shut Down

A thermal shutdown function is effective in the following block.

DC/DC (Charge Pump)
LED Driver
SBIAS
LDO1, LDO2, LDO3, LDO4

The thermal shutdown function is detection temperature that it works is about 195℃.
Detection temperature has a hysteresis, and detection release temperature is about 175 ℃.(Design reference value)

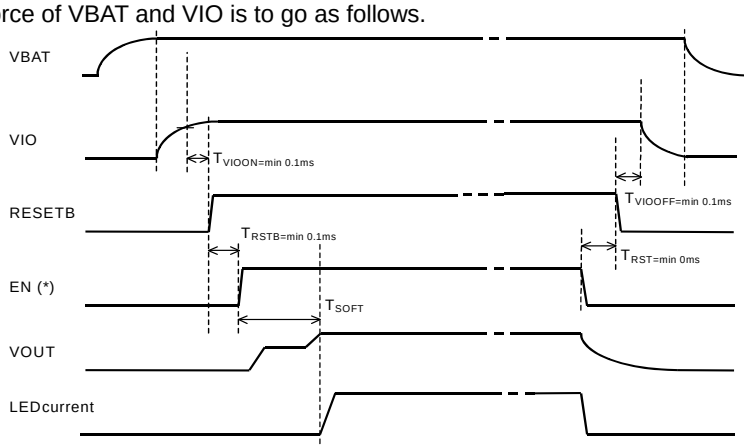
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●DC/DC

Start

DC/DC circuit operates when any LED turns ON. (DCDCFON=0)
When the start of the DC/DC circuit is done, it has the soft start function to prevent a rush current.
Force of VBAT and VIO is to go as follows.



(*) An EN signal means the following in the upper figure.
EN = “MLEDEN” or “W ∗ EN”
(= LED The LED lighting control of a setup of connection VOUT)
But, as for Ta > T_{TSD} (typ : 195° C), a protection function functions, and an EN signal doesn't become effective.
T_{SOFT} changes by the capacitor connected to VOUT and inside OSC.
T_{SOFT} is Typ 200μs (when the output capacitor of VOUT =1.0μF).

Figure10.

Over Voltage protection / Over Current protection
DC/DC circuit output (VOUT) is equipped with the over-voltage protection and the over current protection function.
A VOUT over-voltage detection voltage is about 5.6V(typ). (VOUT at the time of rise in a voltage)
A detection voltage has a hysteresis, and a detection release voltage is about 5.4V (typ).
And, when VOUT output short to ground, input current of the battery terminal is limited by an over current protection function.

Mode transition

The transition of boosts multiple transits automatically by VBAT Voltage and the VOUT Pin Voltage.

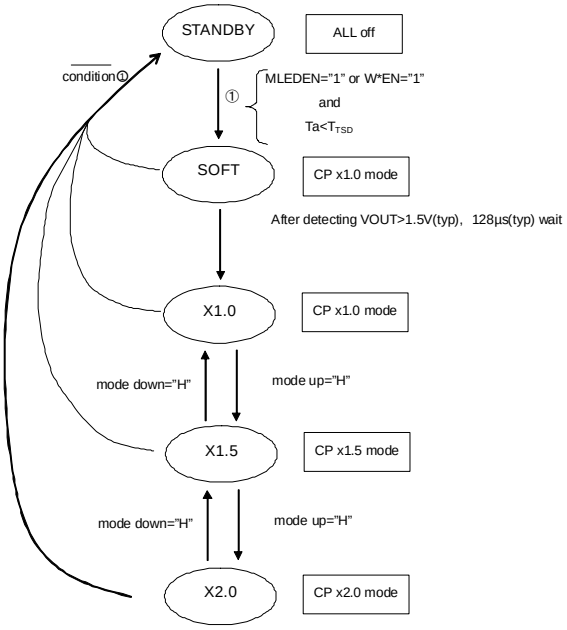


Figure 11.

The mode transition of the charge pump works as follows.

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＜x1.0→x1.5→x2.0 Mode transition＞

The transition of the mode is done when VOUT was compared with VBAT and the next condition was satisfied.

x1.0→x1.5 Mode transition VBAT ≤ VOUT + (Ron10×Iout) (LED Pin feedback:VOUT = Vf+0.2(Typ)) x1.5→x2.0 Mode transition VBAT×1.5 ≤ VOUT +(Ron15×Iout) (LED Pin feedback:VOUT = Vf+0.2(Typ))

Ron10: x1 Charge pump on resistance 1.2Ω(Typ)
Ron15: x1.5 Charge pump on resistance 7.1Ω(Typ)

＜x2.0→x1.5→x1.0 Mode transition＞

The transition of the mode is done when the ratio of VOUT and VBAT is detected and it exceeds a fixed voltage ratio.

x1.5→x1.0 Mode transition VBAT / VOUT =1.16(Design value) x2.0→x1.5 Mode transition VBAT / VOUT =1.12(Design value)

●LED Driver

The LED driver of 8ch is constructed as the ground plan.
Equivalence control is possible with LED1 to 4(LED4 can choose use/un-use with a register W4MD.).
LED5, LED6, LED7, LED8 is controllable individually.
As for LED5 to 8, grouping setting to the main control is possible, and main control becomes effective for the main group in the allotment. LED5 to 8 are setups of grouping to the main control.
When LED5 to 8 are used by the individual control, a slope time setup (register THL and TLH) doesn't become effective.

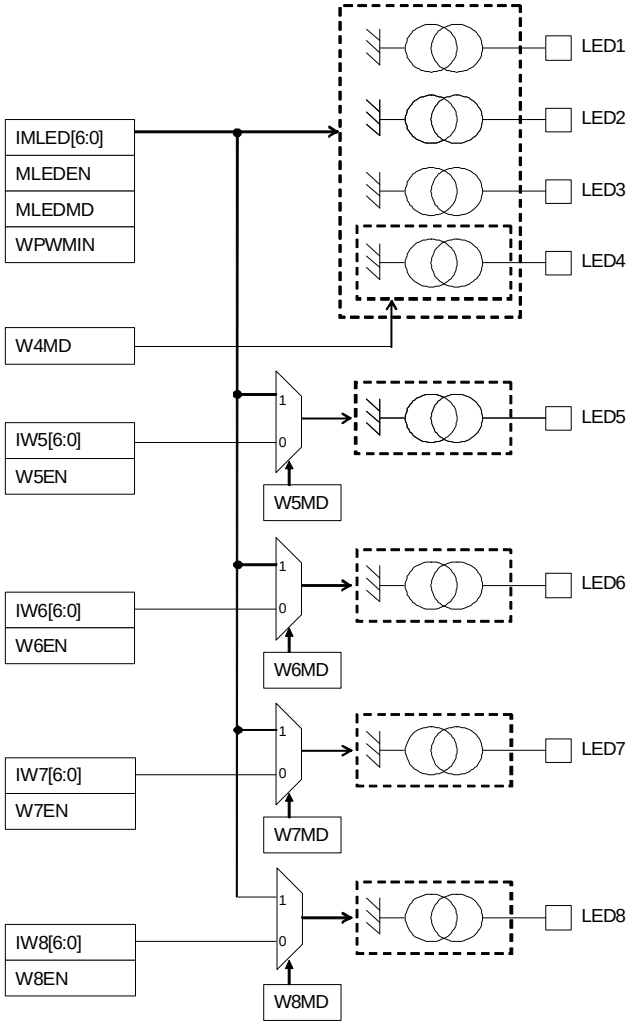


Figure 12.

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LED Composition which can be set up is the following.

Main (ALC,PWM)	Other1	Other2	Other3	Other4
8LEDs	-	-	-	-
7LEDs	-	-	-	-
7LEDs	1LED	-	-	-
6LEDs	-	-	-	-
6LEDs	1 LED	-	-	-
6LEDs	2 LEDs	-	-	-
6LEDs	1 LED	1LED	-	-
5LEDs	-	-	-	-
5LEDs	1 LED	-	-	-
5LEDs	2 LEDs	-	-	-
5LEDs	1 LED	1LED	-	-
5LEDs	3 LEDs	-	-	-
5LEDs	2 LEDs	1LED	-	-
5LEDs	1 LED	1LED	1LED	-
4LEDs	-	-	-	-
4LEDs	1 LED	-	-	-
4LEDs	2 LEDs	-	-	-
4LEDs	1 LED	1LED	-	-
4LEDs	3 LEDs	-	-	-
4LEDs	2 LEDs	1LED	-	-
4LEDs	1 LED	1LED	1LED	-
4LEDs	4LEDs	-	-	-
4LEDs	3 LEDs	1LED	-	-
4LEDs	2 LEDs	1LED	1LED	-
4LEDs	1 LED	1LED	1LED	1LED
3LEDs	-	-	-	-
3LEDs	1 LED	-	-	-
3LEDs	2 LEDs	-	-	-
3LEDs	1 LED	1LED	-	-
3LEDs	3 LEDs	-	-	-
3LEDs	2 LEDs	1LED	-	-
3LEDs	1 LED	1LED	1LED	-
3LEDs	4LEDs	-	-	-
3LEDs	3 LEDs	1LED	-	-
3LEDs	2 LEDs	1LED	1LED	-
3LEDs	1 LED	1LED	1LED	1LED

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●ALC (Auto Luminous Control)

LCD backlight current adjustment is possible in the basis of the data detected by external ambient light sensor.

- Extensive selection of the ambient light sensors (Photo Diode, Photo Transistor, Photo IC(linear/logarithm)) is possible by building adjustment feature of Sensor bias, gain adjustment and offset adjustment.
- Ambient data is changed into ambient level by digital data processing, and it can be read through I^2C I/F.
- Register setting can customize a conversion to LED current. (Initial Value is pre-set.)
- Natural dimming of LED driver is possible with the adjustment of the current transition speed.

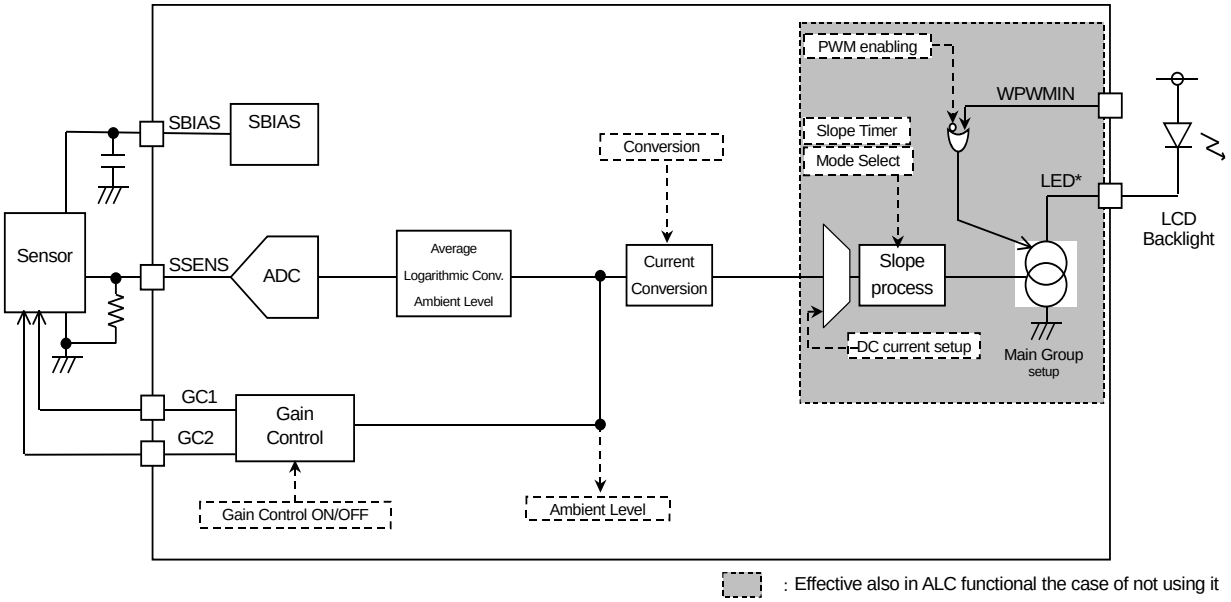


Figure 13.

(1) Auto Luminous Control ON/OFF

- ALC block can be independent setting ON/OFF.
- It can use only to measure the Ambient level.
  Register: ALCEN
  Register: MLEDEN
  Register: MLEDMD
- Refer to under about the associate ALC mode and Main LED current.

ALCEN	MLEDEN	MLEDMD	Sensor I/F	LED control	Mode	Main LED current
0	0	x	OFF (AMB(3:0)=0h)	OFF	OFF	-
0	1	0		ON	Non ALC mode	IMLED(6:0)
0	1	1				IU0(6:0) (*1)
1	0	x	ON	OFF	ALC mode	-
1	1	0		ON		IMLED(6:0)
1	1	1				ALC mode (*2)

(*1) At this mode, because Sensor I/F is OFF, AMB(3:0)=0h.
So, Main LED current is selected IU0(6:0).

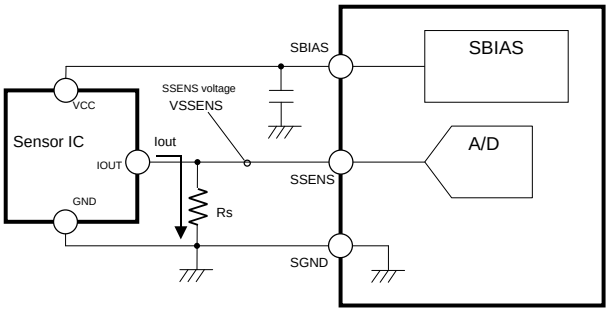
(*2) At this mode, Main LED current is calculated (See(8)Convert LED Current)
It becomes current value corresponding to each brightness.

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(2) I/V conversion

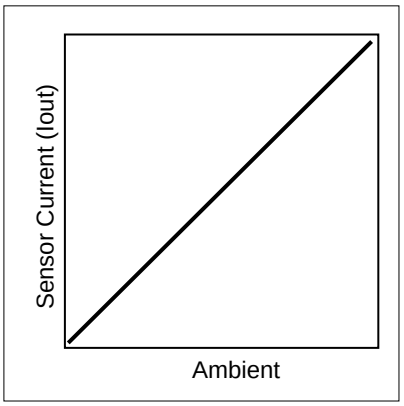
・External resistance for the I-V conversion (Rs)
are adjusted with adaptation of sensor characteristic

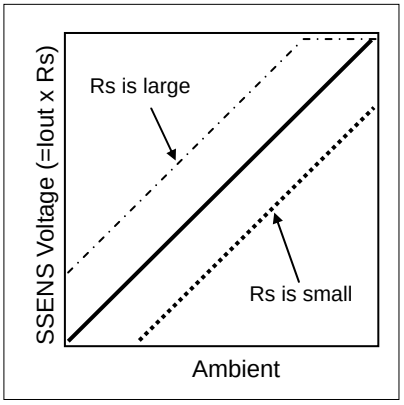


Rs : Sense resistance (A sensor output current is changed into the voltage value.)
SBIAS : Bias power supply terminal for the sensor
SSENS : Sense voltage input terminal

SSENS Voltage = Iout x Rs

Figure 14.



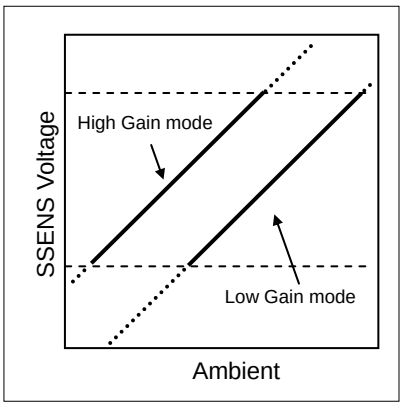


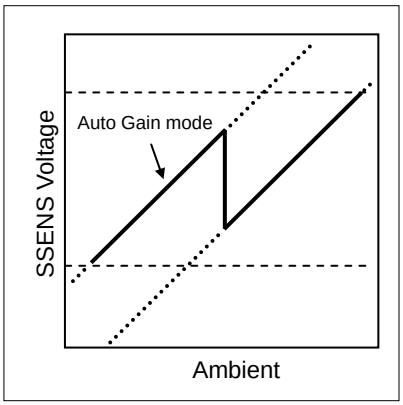
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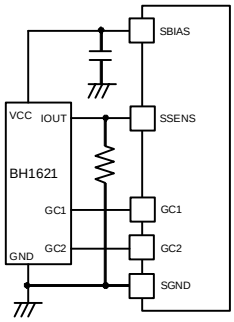
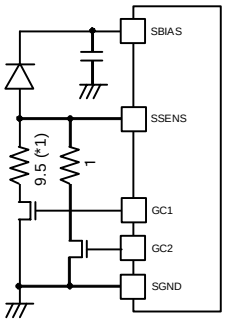
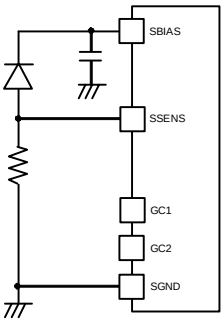
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(3)Gain control

- Sensor gain switching function is built in to extend the dynamic range.
- It is controlled by register setup.
- When automatic gain control is off, the gain status can be set up in the manual.
  Register : GAIN
- GC1 and GC2 are outputted corresponding to each gain status.





	Example 1 (Use BH1621FVC)		Example 2		Example 3
Application example			 Resistor values are relative		
Operating mode	Auto		Auto		Fixed
GAIN setting	0		0		1
Gain status	High	Low	High	Low	-
GC1 output	⎍	L	⎍	L	⎍
GC2 output	L	⎍	L	⎍	L

⎍ : This means that it becomes High with A/D measurement cycle synchronously.
(*1) : Set up the relative ratio of the resistance in the difference in the brightness change of the High Gain mode and the Low Gain mode carefully.

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(4) A/D conversion

- The detection of ambient data is done periodically for the low power.
- SBIAS and ADC are turned off except for the ambient measurement.
- The sensor current may be shut in this function, it can possible to decrease the current consumption.
- SBIAS pin and SSENS pin are pull-down in internal when there are OFF.
- SBIAS circuit has the two modes. (Usually ON mode or intermittent mode)
  Register : ADCYC
  Register : SBIASON

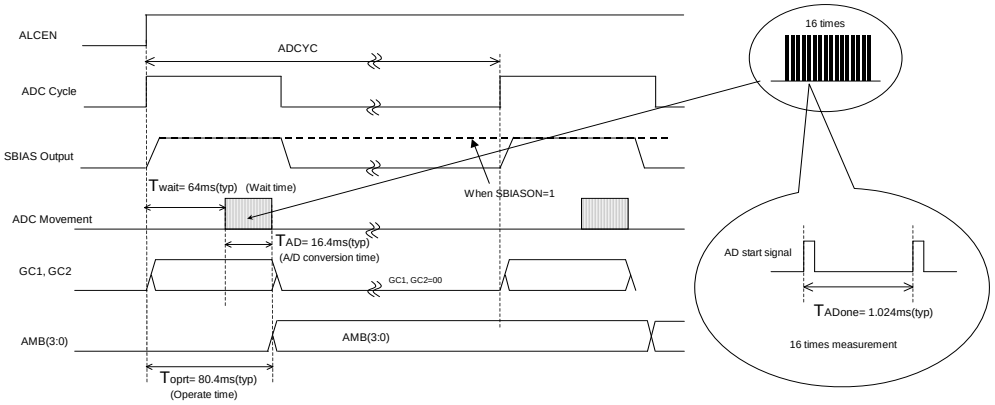


Figure 15.

(5) Average filter

- Average filter is built in to rid noise or flicker.
- Average is 16 times

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(6) Ambient level detection

- Averaged A/D value is converted to Ambient level corresponding to Gain control.
- Ambient level is judged to rank of 16 steps by ambient data.
- Ambient level is output through I^2C.
  Register : AMB(3:0)

STYPE	0			1
GAIN	0		1	-
GAIN Setting	Low	High	-	-
Ambient Level	SSENS Voltage			
0h		VoS × 0 / 256	VoS × 0 / 256	VoS × 0 / 256 VoS × 17 / 256
1h		VoS × 1 / 256	VoS × 1 / 256	VoS × 18 / 256 VoS × 26 / 256
2h		VoS × 2 / 256	VoS × 2 / 256	VoS × 27 / 256 VoS × 36 / 256
3h		VoS × 3 / 256 VoS × 4 / 256	VoS × 3 / 256 VoS × 4 / 256	VoS × 37 / 256 VoS × 47 / 256
4h		VoS × 5 / 256 VoS × 7 / 256	VoS × 5 / 256 VoS × 6 / 256	VoS × 48 / 256 VoS × 59 / 256
5h	VoS × 0 / 256	VoS × 8 / 256 VoS × 12 / 256	VoS × 7 / 256 VoS × 9 / 256	VoS × 60 / 256 VoS × 71 / 256
6h	VoS × 1 / 256	VoS × 13 / 256 VoS × 21 / 256	VoS × 10 / 256 VoS × 13 / 256	VoS × 72 / 256 VoS × 83 / 256
7h	VoS × 2 / 256 VoS × 3 / 256	VoS × 22 / 256 VoS × 37 / 256	VoS × 14 / 256 VoS × 19 / 256	VoS × 84 / 256 VoS × 95 / 256
8h	VoS × 4 / 256 VoS × 6 / 256	VoS × 38 / 256 VoS × 65 / 256	VoS × 20 / 256 VoS × 27 / 256	VoS × 96 / 256 VoS × 107 / 256
9h	VoS × 7 / 256 VoS × 11 / 256	VoS × 66 / 256 VoS × 113 / 256	VoS × 28 / 256 VoS × 38 / 256	VoS × 108 / 256 VoS × 119 / 256
Ah	VoS × 12 / 256 VoS × 20 / 256	VoS × 114 / 256 VoS × 199 / 256	VoS × 39 / 256 VoS × 53 / 256	VoS × 120 / 256 VoS × 131 / 256
Bh	VoS × 21 / 256 VoS × 36 / 256	VoS × 200 / 256 VoS × 255 / 256	VoS × 54 / 256 VoS × 74 / 256	VoS × 132 / 256 VoS × 143 / 256
Ch	VoS × 37 / 256 VoS × 64 / 256		VoS × 75 / 256 VoS × 104 / 256	VoS × 144 / 256 VoS × 155 / 256
Dh	VoS × 65 / 256 VoS × 114 / 256		VoS × 105 / 256 VoS × 144 / 256	VoS × 156 / 256 VoS × 168 / 256
Eh	VoS × 115 / 256 VoS × 199 / 256		VoS × 145 / 256 VoS × 199 / 256	VoS × 169 / 256 VoS × 181 / 256
Fh	VoS × 200 / 256 VoS × 255 / 256		VoS × 200 / 256 VoS × 255 / 256	VoS × 182 / 256 VoS × 255 / 256

※ In the Auto Gain control mode, sensor gain changes in gray-colored ambient level.
※ "/" : This means that this zone is not outputted in this mode.

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(7) Convert LED Current

・LED current can be assigned as each of 16 steps of the ambient level.

・Convert LED Current by Min Current setting,Max Current setting,step setting and curbu setting.

Register : IU0
IU1
CRV
STEP[2:0]

Conversion Table (Initial Value)

Ambient Level	Coefficient		Ambient Level	Coefficient	
	CRV=0	CRV=1		CRV=0	CRV=1
0h	0	0	8h	6.5	8
1h	0.25	1	9h	8	9
2h	0.5	2	Ah	10	10
3h	1	3	Bh	12	11
4h	1.5	4	Ch	13	12
5h	2.5	5	Dh	14	13
6h	3.5	6	Eh	15	14
7h	5	7	Fh	16	15

Step Table Setting

STEP[2:0]	ΔI
000	1.0mA
001	1.1mA
010	1.2mA
011	1.3mA
100	1.6mA
101	1.7mA
110	1.8mA
111	1.9mA

I=ΔI × Coefficient+IU0

※ I≧IU1:I=IU1

※ ΔI × Coefficient
Drop under 1mA

The example of a setting
IU0=4mA
IU1=20mA

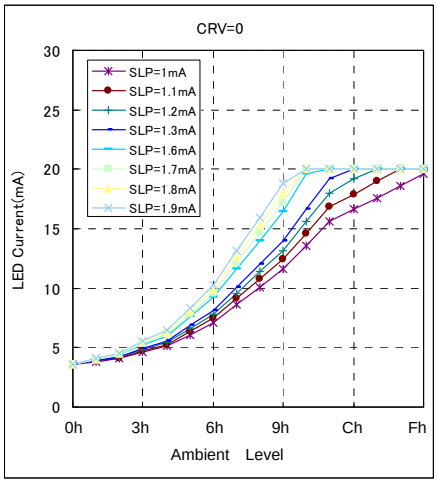


Figure 16.

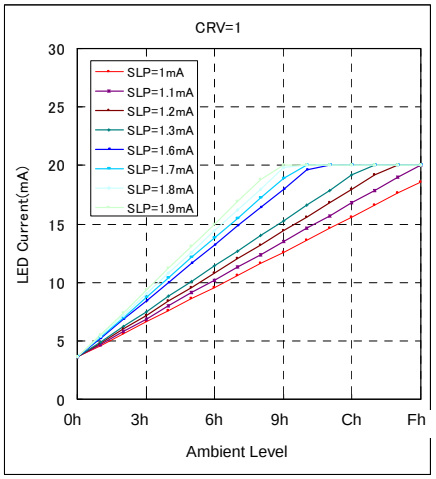


Figure 17.

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(8) Slope process

- Slope process is given to LED current to dim naturally.
- LED current changes in the 256Step gradation in sloping.
- Up(dark→bright),Down(bright→dark)
  LED current transition speeds are set individually.
  Register : THL(3:0)
  Register : TLH(3:0)
- Main LED current changes as follows at the time as the slope.
  TLH (THL) is setup of time of the current step 2/256.

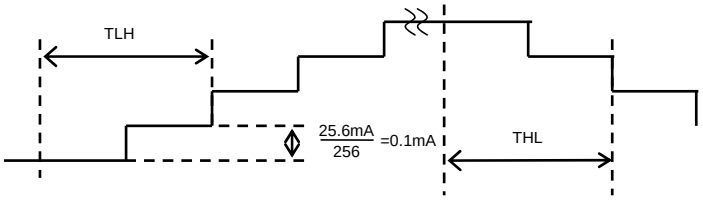
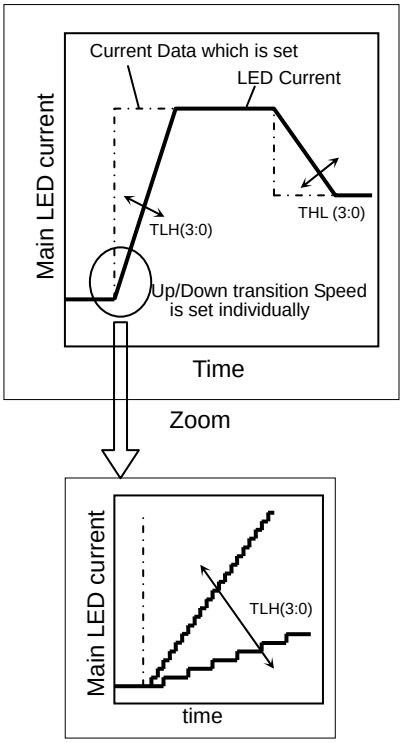
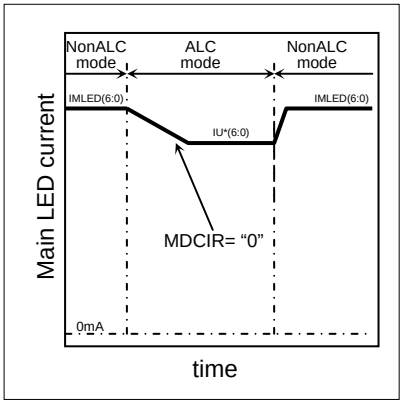


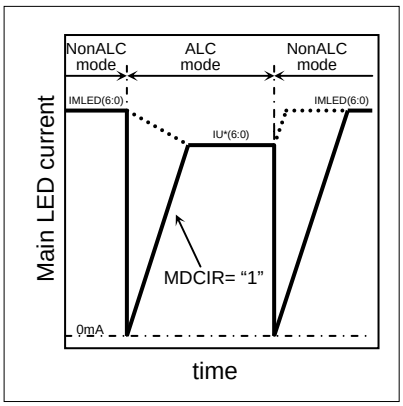
Figure 18.



(9) LED current reset when mode change

- When mode is changed (ALC↔Non ALC),
  it can select the way to sloping.
  Register : MDCIR
  "0" : LED current non-reset when mode change
  "1" : LED current reset when mode change





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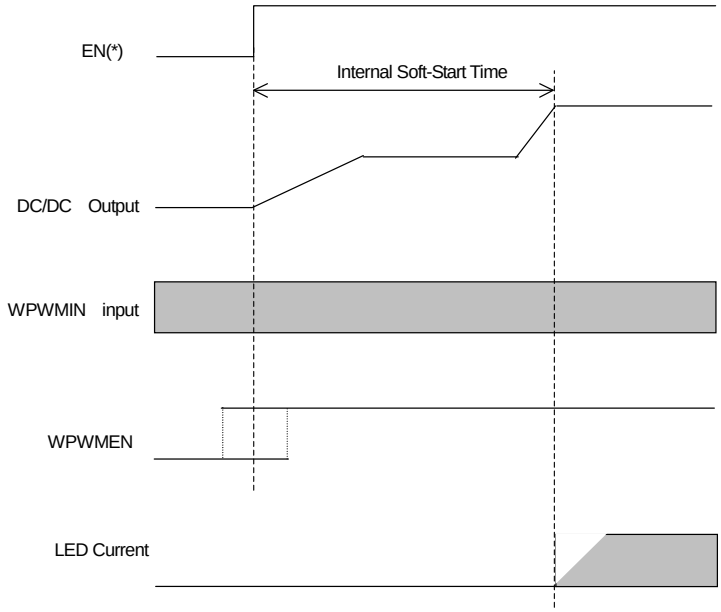
(10) Current adjustment

・When the register setting permits it, PWM drive by the external terminal (WPWMIN) is possible.
Register : WPWMEN

・It is suitable for the intensity correction by external control, because PWM based on Main LED current of register setup or ALC control.

WPWMEN (Register)	WPWMIN(External Pin)	Main group LED current
0	L	Normal operation
	H	Normal operation
1	L	Forced OFF
	H	Normal operation

" Normal operation " depends on the setup of each register.



EN(*) : it means “MLEDEN” or “W*EN”.

It is possible to make it a WPWMIN input and WPWMEN=1 in front of EN(*).
A PWM drive becomes effective after the time of an LED current standup.

When rising during PWM operation, as for the standup time of a DC/DC output, only the rate of PWM Duty becomes late. Appearance may be influenced when extremely late frequency and extremely low Duty are inputted.

Please secure 250 µs or more of H sections at the time of PWM pulse Force.

Figure 19.

●I/O

When the RESETB pin is Low, the input buffers (SDA and SCL) are disabling for the Low consumption power.

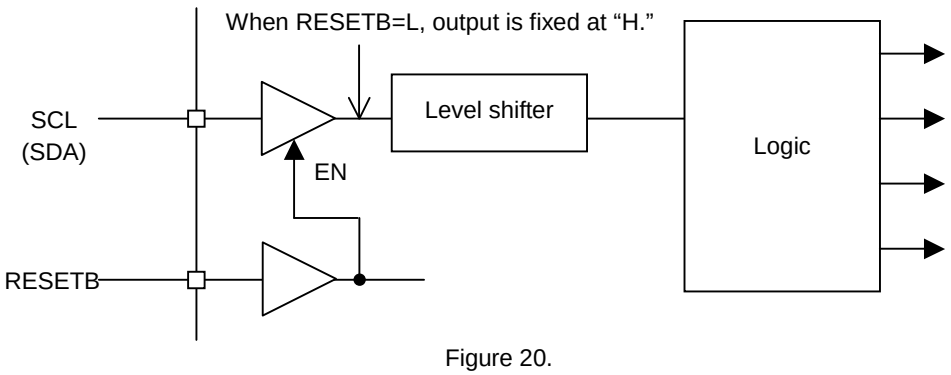


Figure 20.

Special care should be taken because a current path may be formed via a terminal protection diode, depending on an I/O power-on sequence or an input level.

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●About the Start of LD1 to LDO4

It must start as follows.

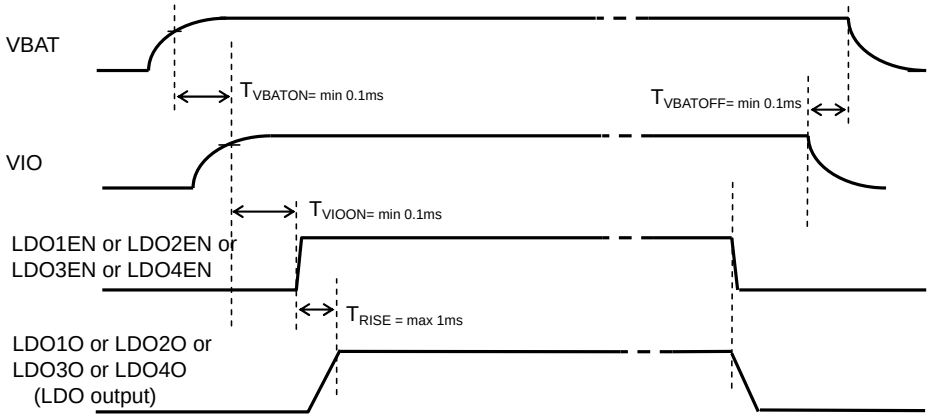


Figure 21.

<Start Sequence>

VBAT ON (Enough rise up) → VIO ON (Enough rise up) → Reset release → LDO ON (Register access acceptable)

<End Sequence>

LDO OFF → Reset → VIO OFF (Enough fall down) → VBAT OFF

●About the Pin Management of the Function That Isn't Used and Test Pins

Setting it as follows is recommended with the test pin and the pin which isn't used.
Set up pin referring to the "Equivalent circuit diagram" so that there may not be a problem under the actual use.

T2, T4	Short to GND because pin for test input
T1, T3	OPEN because pin for test output
Non-used LED Pin	Short to GND (Must) Don't set the register concerned with non-used LED Pin
WPWMIN	Short to ground (A Pull-Down resistance built-in terminal is contained, too.)
LDO1O, LDO2O LDO3O, LDO4O	OPEN because pin for output

●Operation Settings (Flow Example)

1. Backlight: Auto Luminous Mode

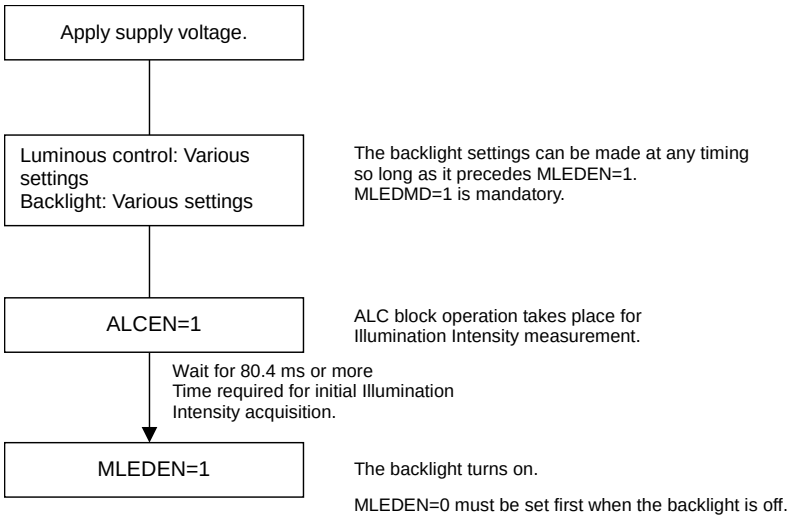


Figure 22.

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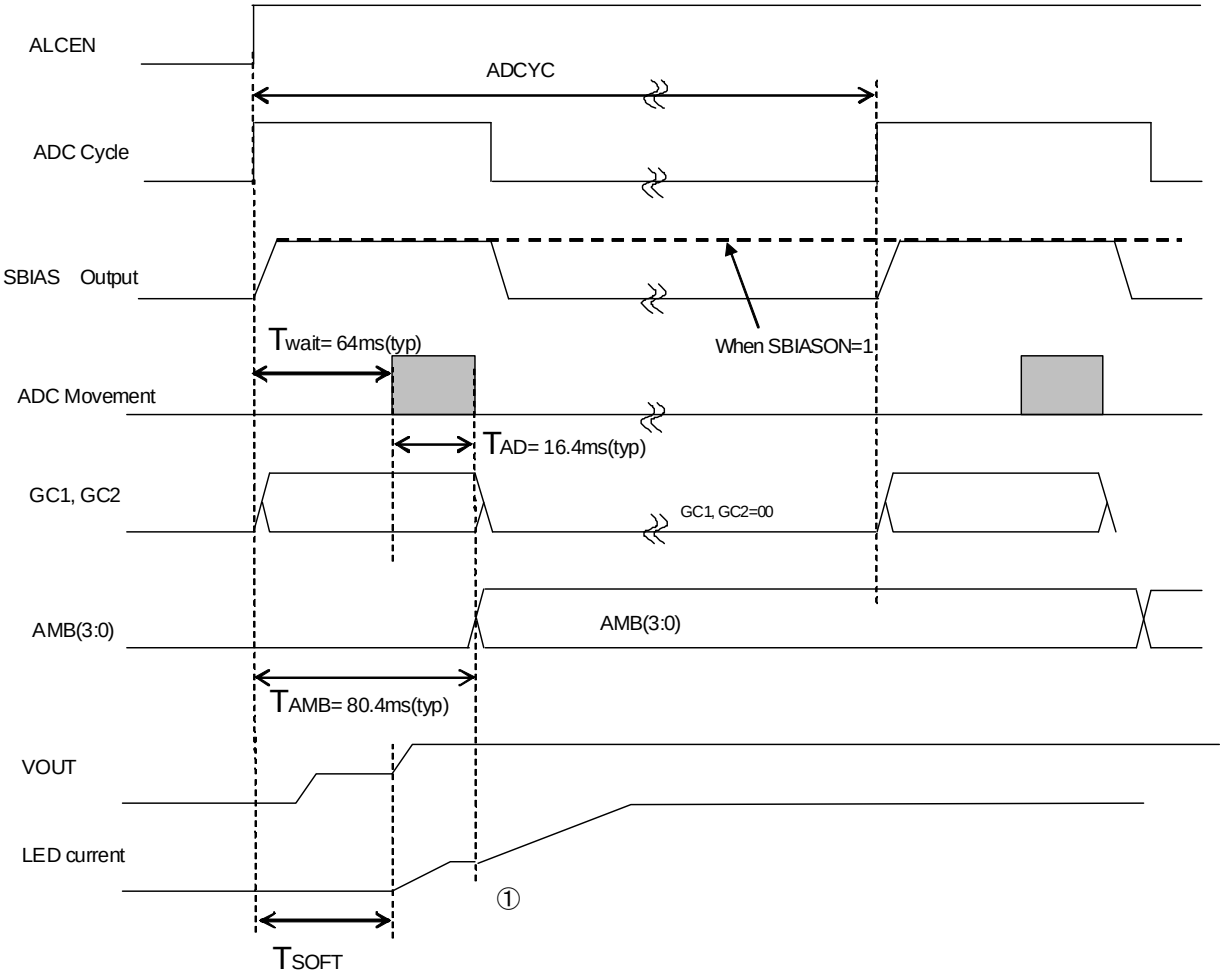


Figure 23.

When it cannot wait for the first illumination measurement, backlight lighting is possible with ALCEN.
But the extremely short case of slope rise time, a shoulder may be done like ① for an LED electric current.
(To the first illumination measurement for AMB(3:0)=00h)

2. Backlight: Fade-in/Fade-out

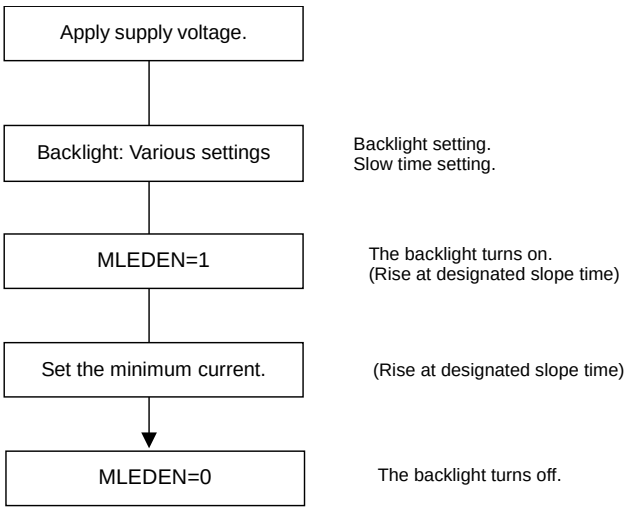


Figure 24.

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3. Backlight without Auto Luminous Mode

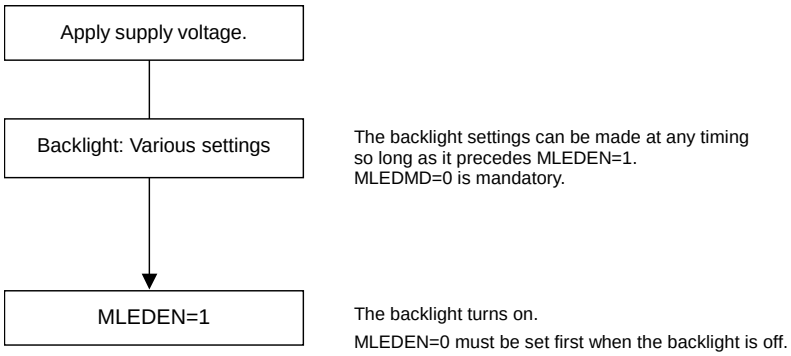


Figure 25.

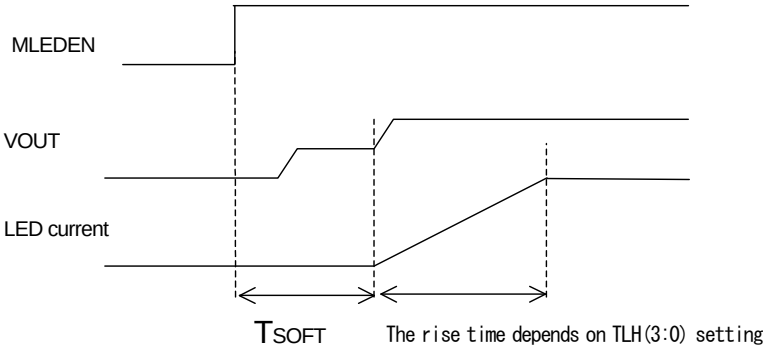
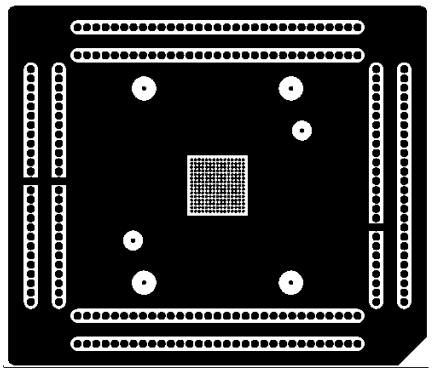


Figure 26.

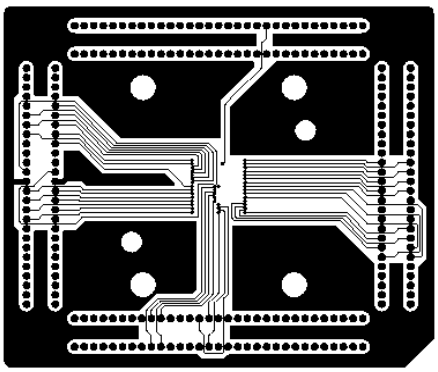
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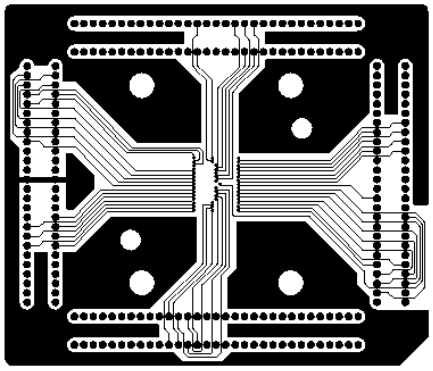
●**PCB Pattern of the Power Dissipation Measuring Board**



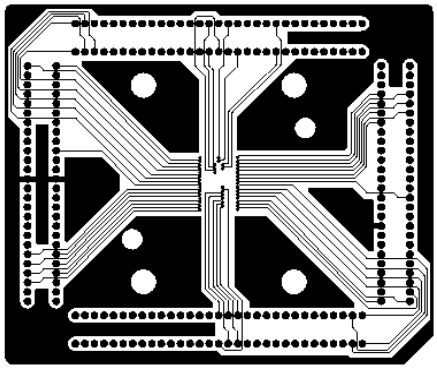
1st layer(component)



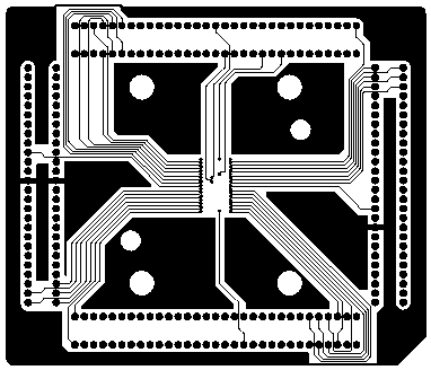
2nd layer



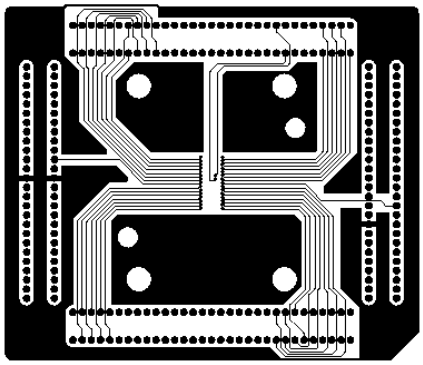
3rd layer



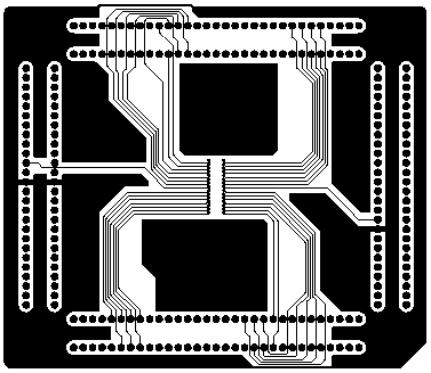
4th layer



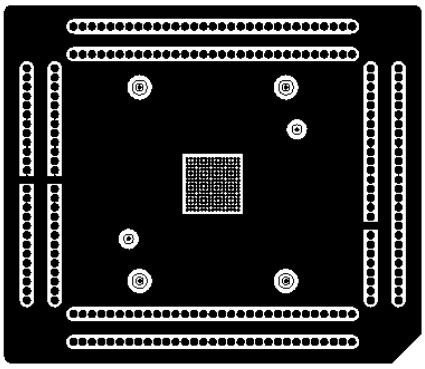
5th layer



6th layer



7th layer



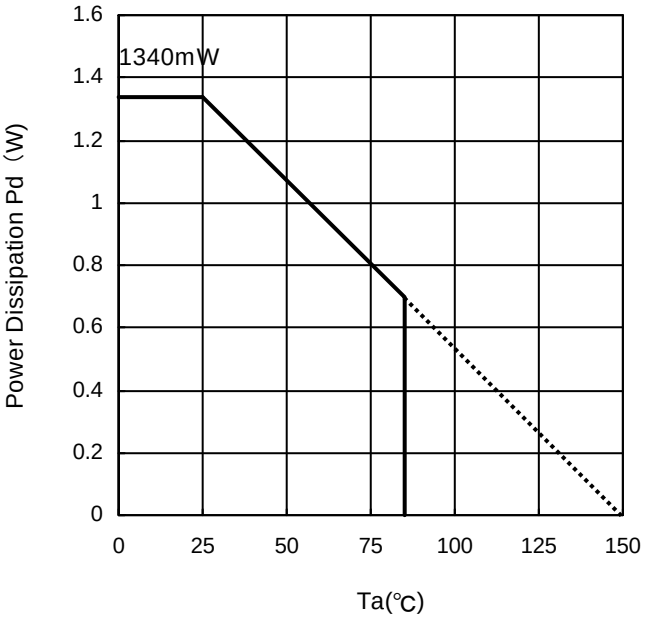
8th layer(solder)

Figure 27. PCB Pattern of the Power Dissipation Measuring Board

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●**Power Dissipation (On the ROHM's Standard Board)**



Information of the ROHM's standard board
Material: glass-epoxy
Size : 50mm × 58mm × 1.75mm(8th layer)
Wiring pattern figure Refer to page 42.

Figure 28. Power Dissipation

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●Application Circuit Examples

Example 1

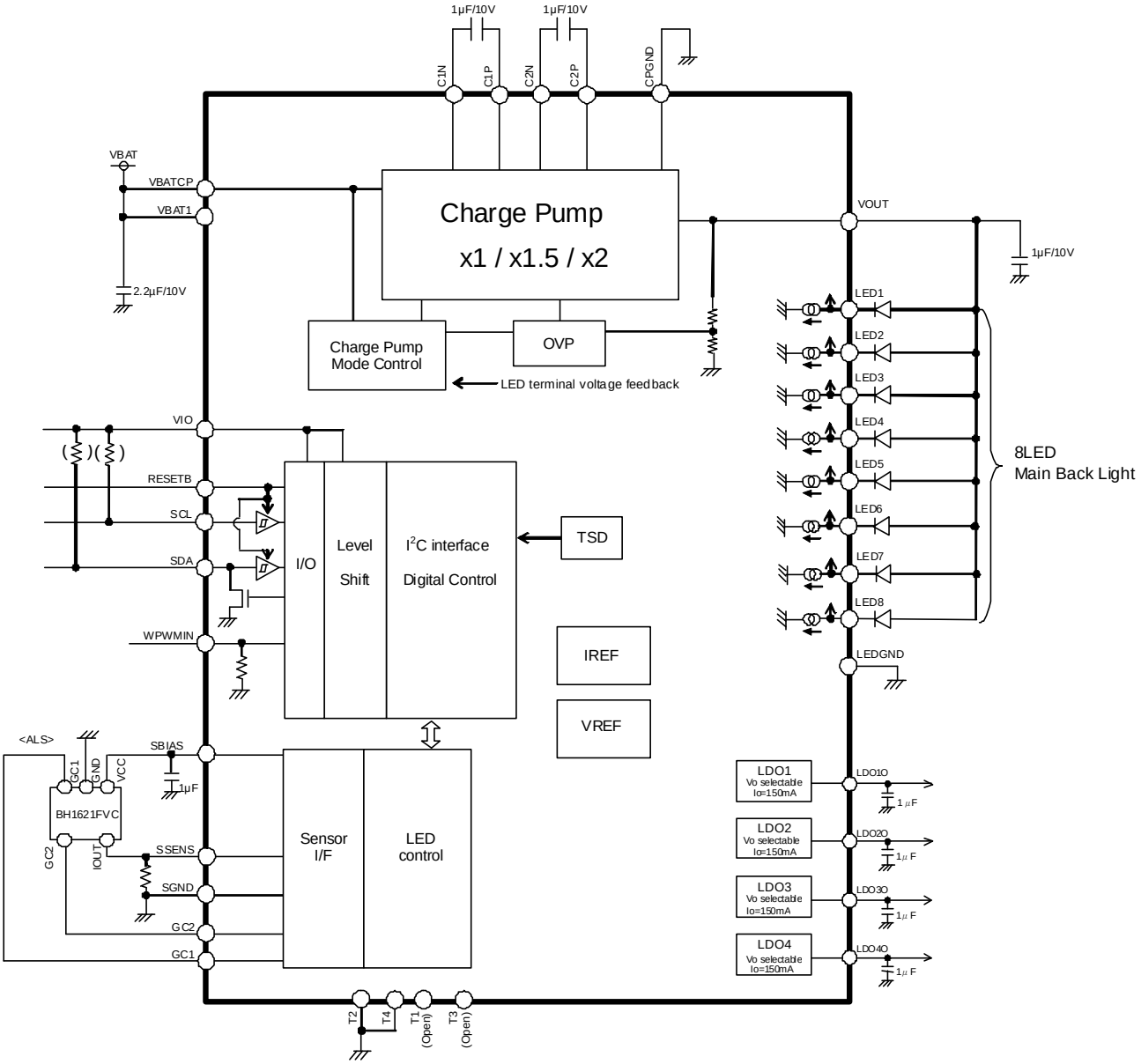


Figure 29. Application Circuit Example 1

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Example 2

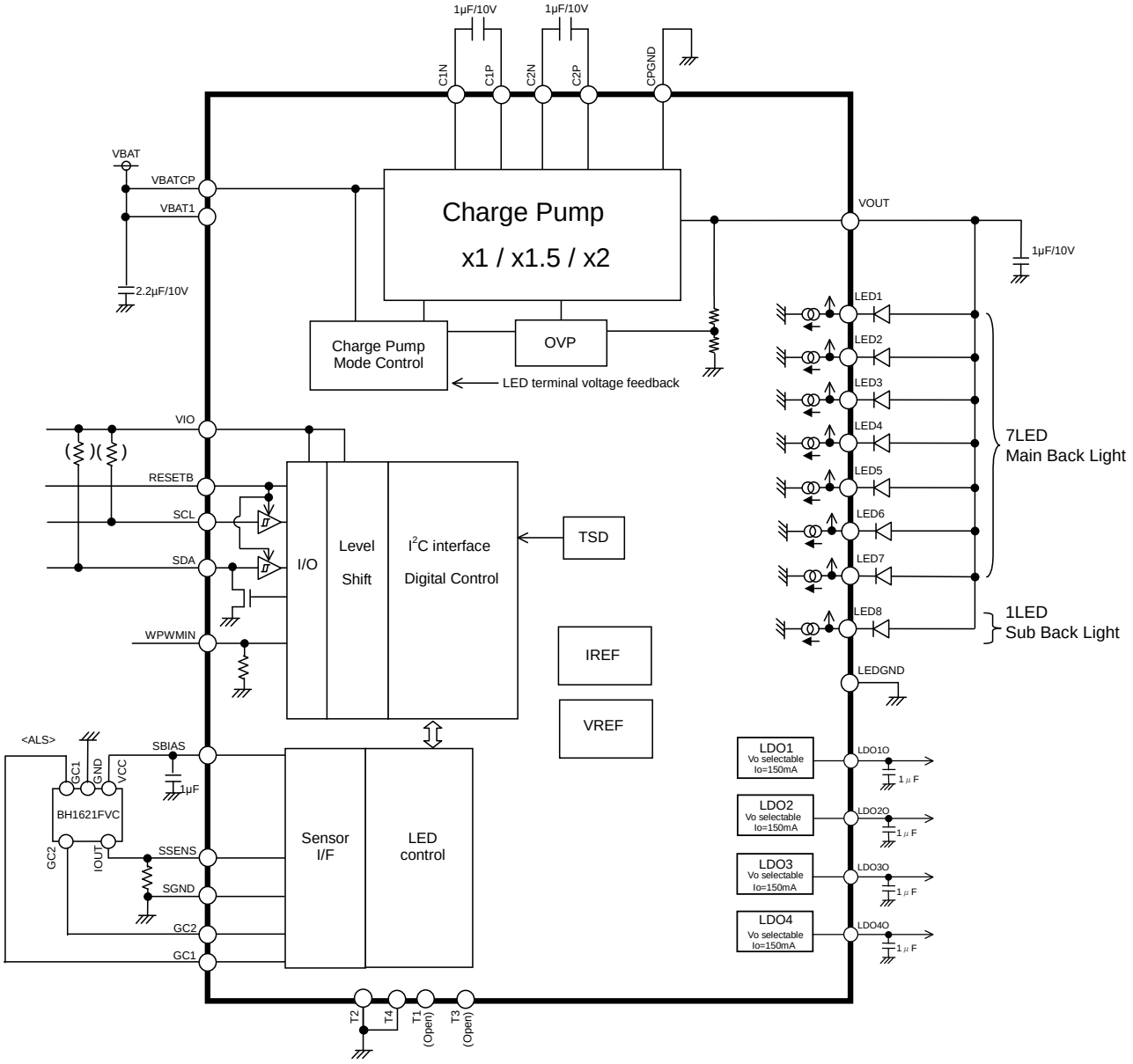


Figure 30. Application Circuit Example 2

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Example 3

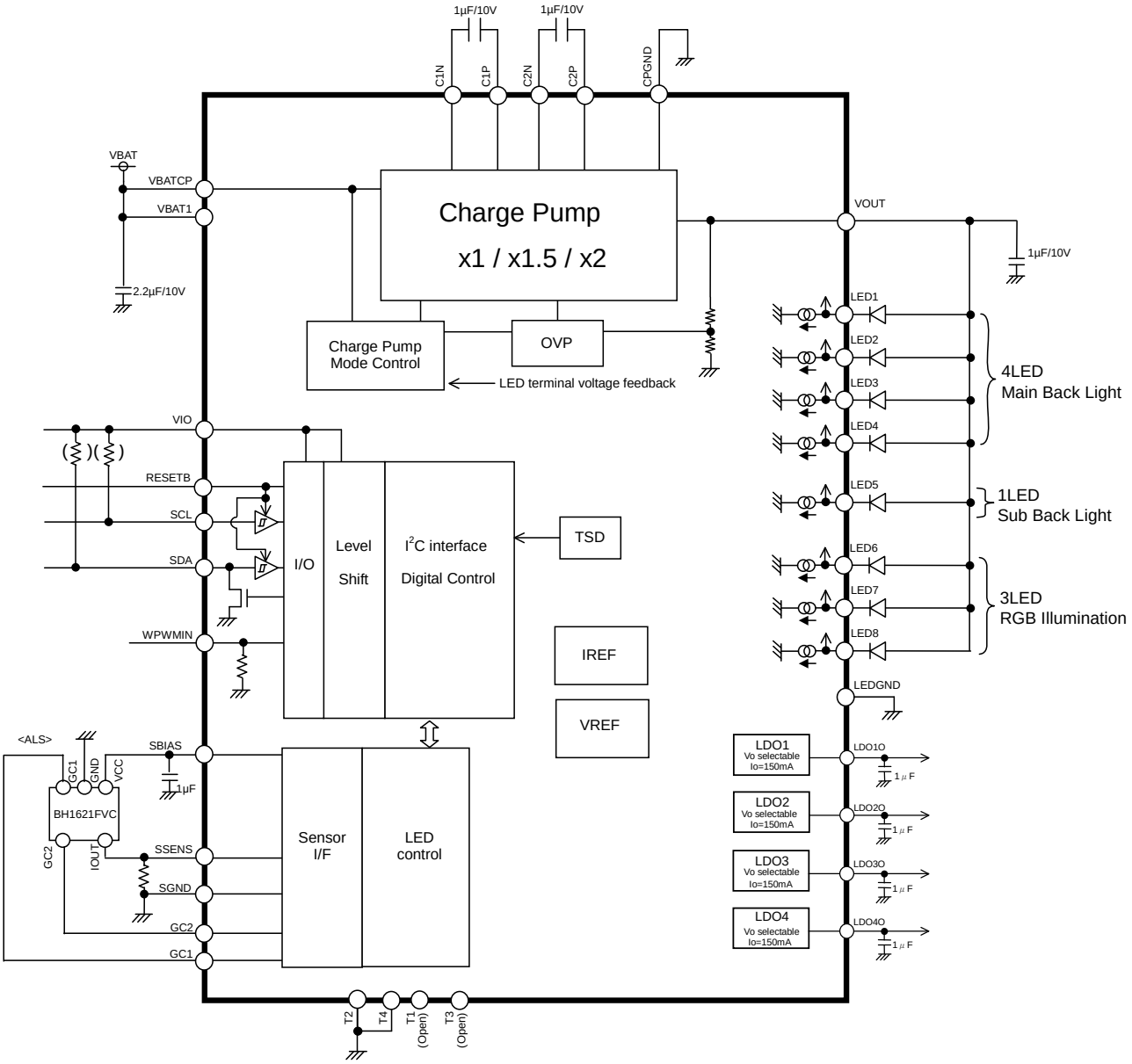


Figure 31. Application Circuit Example 3

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●**Operational Notes**

(1) Absolute Maximum Ratings
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

(2) Power supply and ground line
Design PCB pattern to provide low impedance for the wiring between the power supply and the ground lines. Pay attention to the interference by common impedance of layout pattern when there are plural power supplies and ground lines. Especially, when there are ground pattern for small signal and ground pattern for large current included the external circuits, please separate each ground pattern. Furthermore, for all power supply pins to ICs, mount a capacitor between the power supply and the ground pin. At the same time, in order to use a capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.

(3) Ground voltage
Make setting of the potential of the ground pin so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no pins are at a potential lower than the ground voltage including an actual electric transient.

(4) Short circuit between pins and erroneous mounting
In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between pins or between the pin and the power supply or the ground pin, the ICs can break down.

(5) Operation in strong electromagnetic field
Be noted that using ICs in the strong electromagnetic field can malfunction them.

(6) Input pins
In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input pin. Therefore, pay thorough attention not to handle the input pins, such as to apply to the input pins a voltage lower than the ground respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input pins a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

(7) External capacitor
In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.

(8) Thermal shutdown circuit (TSD)
This IC builds in a thermal shutdown (TSD) circuit. When junction temperatures become detection temperature or higher, the thermal shutdown circuit operates and turns a switch OFF. The thermal shutdown circuit, which is aimed at isolating the IC from thermal runaway as much as possible, is not aimed at the protection or guarantee of the IC. Therefore, do not continuously use the IC with this circuit operating or use the IC assuming its operation.

(9) Thermal design
Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use.

(10) LDO
Use each output of LDO by the independence. Don't use under the condition that each output is short-circuited because it has the possibility that an operation becomes unstable.

(11) About the rush current
For ICs with more than one power supply, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of wiring.

Status of this document
The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.
If there are any differences in translation version of this document formal version takes priority.

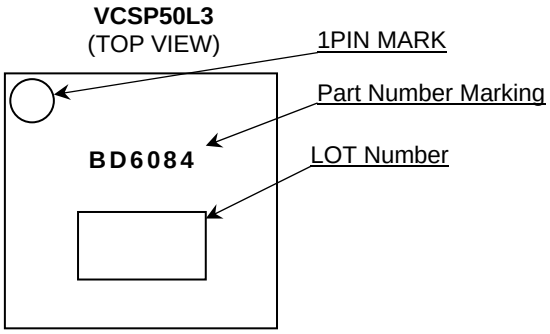
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●Ordering Information

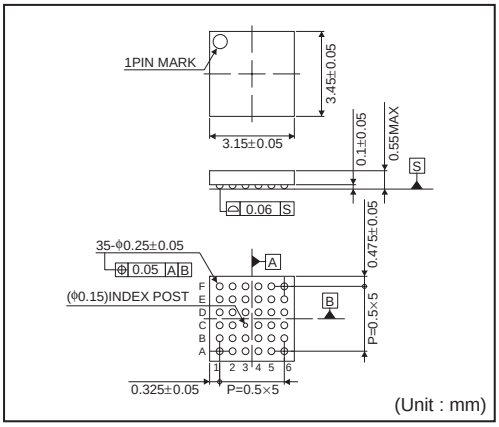
B D 6 0 8 4 G U L	-	E 2
Part Number		Package GUL: VCSP50L3
		Packaging and forming specification E2: Embossed tape and reel

●Marking Diagram



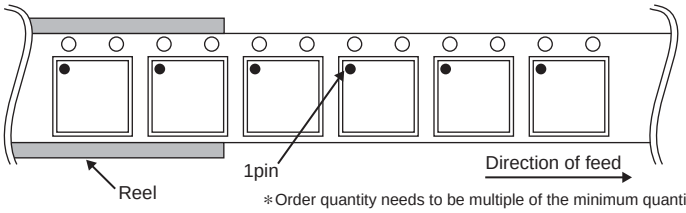
●Physical Dimension Tape and Reel Information

VCSP50L3(BD6084GUL)



<Tape and Reel information>

Tape	Embossed carrier tape (heat sealing method)
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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●**Revision History**

Date	Revision	Changes
16.Oct.2012	001	New Release

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Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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